November 8, 1928

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Engineering News-Record

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Setting 55-Ton Deck Slab of San Francisco Bay Bridge

Bamuel-Oakland

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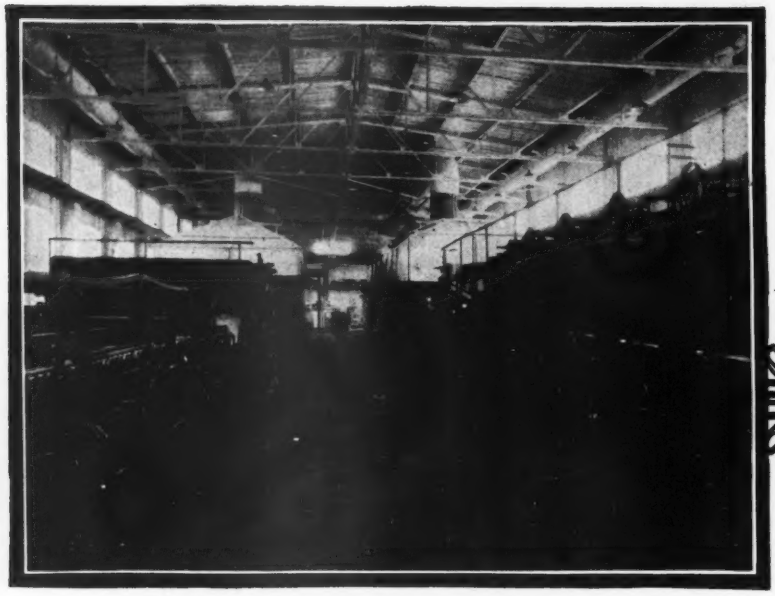

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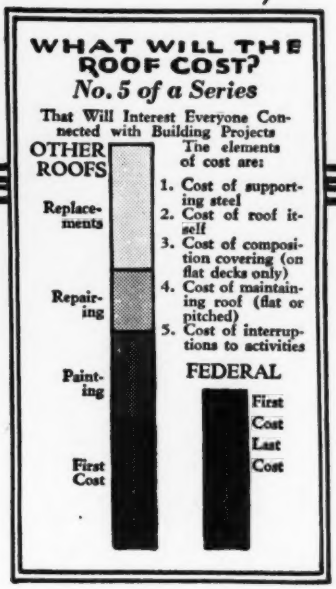
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New York, November 8, 1928

Engineering News-Record

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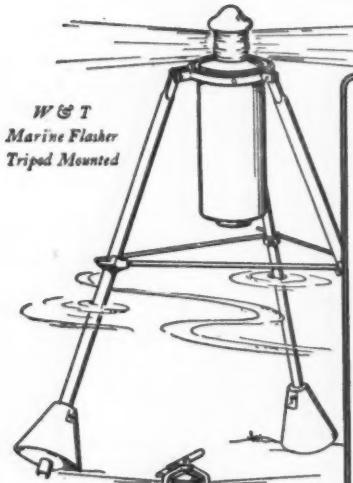

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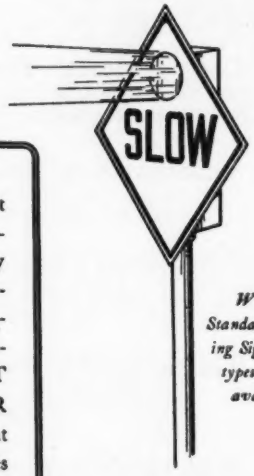

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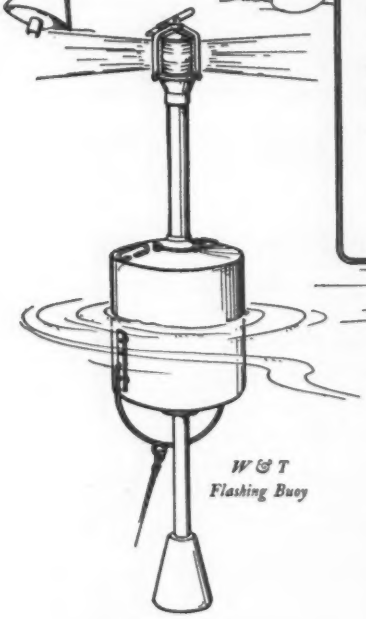

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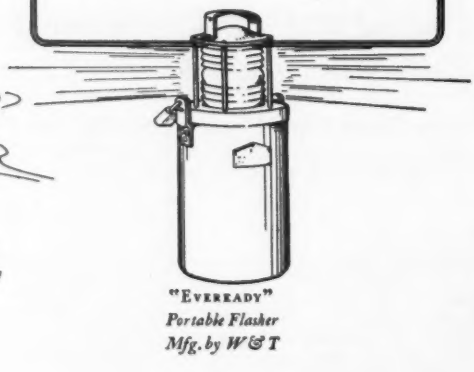

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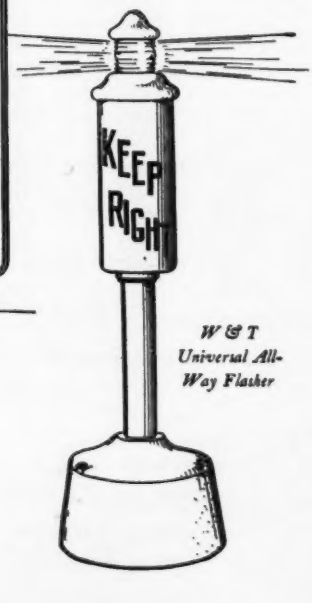

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Volume 101 NEW YORK, NOVEMBER 8, 1928 Number 19

An Engineer to Lead

BY ELECTING Herbert Hoover as President two days ago, the American nation has for the first time placed an engineer at its head. The great event is the culmination of more than a century of the profession's growth, from the obscurity of craftsman performance to a leading place among the mighty of the earth. Seemingly impossible labors at home as well as in the councils of the world await the new chief, labors that involve economic, engineering and human factors in intimate mixture. To these tasks he brings the engineer's attitude of mind—the same outlook and the habit of carefully weighing facts that, amid all the tumult of issues and emotions of the campaign, constituted an essential motive of his choice. The coming four years will show what these great human resources can accomplish.

Transatlantic Air Transportation

ADVENTURE in transatlantic flights gave way to solid achievement when the dirigible "Graf Zeppelin" made its return trip to its European home port last week. Its one-way voyage, like the daring deeds of earlier air pioneers, could be viewed only as a piece of fair-weather luck, but the quick repetition of the feat proves the solid reality of the performance. Furthermore the carrying of some sixty people, besides mail and express freight, comprises our first experience with full-size oceanic air transportation. Without doubt the dirigible is still a fragile device; the stripping of part of the control surfaces of the vessel in its westward trip showed none too great progress since the time of the wreck of the "Shenandoah." But in so young an art these weaknesses are merely matters of immaturity; time, with development of materials and of structural design, will bring greater sturdiness. Then the practical existence of transatlantic air commerce by airships can be more closely evaluated. For the present a new mark of performance has been set, to end, it may be hoped, in recording another step in the progressive reduction of distance which marks the modern age.

A Harbor Problem

HOUSING a monster dirigible still is a large problem. The big shed at Lakehurst proved awkward at both arrival and departure of the German ship. Regardless of how safely a dirigible may be sheltered once it gets in the hangar, the structure surely is not an ideal harbor when a moderate wind interferes with safe entrance or exit. There is room for radical improvement in design of landing and anchorage. The present masts are not suitable for rapid mooring of a ship even in fair weather and are completely inadequate for efficient and safe handling of passengers. As in the case of the existing hangars, they probably fulfill the designer's expectations, but at the same time reveal his lack of vision. In the light of this lesson the present task of devising new forms and methods calls for distinct creative ingenuity. The problem is essentially one for civil engineers, though it may be that their opportunities for dealing with it will be quite limited until we approach closer to placing transportation by dirigibles on a commercial basis.

Railway Electrification

ANNOUNCEMENT by the Pennsylvania Railroad of the plan to begin electrification of its line between Philadelphia and New York City means that recent improvements in steam locomotive design have not been able to offset the advantage of railway electrification. Some people have believed that the effect of these improvements was to postpone electrification on other than suburban commuting lines for an indefinite time. While the recently started Lackawanna electrification is essentially suburban, the projected Pennsylvania work is of a different character. The Pennsylvania's suburban lines around Philadelphia and New York already are partly electrified, including its main line south to Wilmington. The work in immediate prospect will bring these two electrified zones into a complete unit. Eventually electrification will be carried over the mountains to Harrisburg, thus making the advantages of electric traction available to the major lines of the eastern end of the Pennsylvania system. Where a railroad's business is chiefly that of hauling dense through freight traffic, steam locomotive developments probably have postponed resort to electric traction, but where such service combines both dense freight and passenger traffic and within rapidly developing metropolitan areas, electric traction brings economies which cannot be attained by any development of steam locomotives now in sight.

One Line of Progress

NOT long since, when an important engineering project was put into service, there was approving public comment on the orderly and attractive finish of the work. Why this comment? The answer is easily supplied by anyone who has noted the desolation left in the wake of some engineering works of former days—anyone who has, for example, passed along the disfiguring spoilbanks of the Chicago drainage canal, the eyesore of an entire countryside. Years ago the engineer's "art" was often limited to creating something that would work, regardless of a disorderly and hideous exterior. What if other people did not like it? What, indeed! But fortunately the views of those days have been largely outlived. Today a regard for neat and decent finish, not to say esthetically pleasing effect, is the rule rather than the exception among the builders of engineering works. Yet in a measure the practices of former days still dog us, and the engineer is still regarded as an uncouth spoiler—witness the obvious element of surprise in such public comment as mentioned in the opening. A bad name lives

long. Much remains to be done before the old conception has been erased and every engineer appreciates that wanton disfigurement of the landscape is sure to foster an unfriendly attitude toward the profession. Moreover, there are difficulties such as those which have, until recently, kept the railroads from making their rights-of-way other than staring and offensive. But we are making progress, and necessary progress. In time a careful regard for neatness and good appearance in place of brutal rawness will be an integral part of the engineer's habit of thought.

Lessons in a Building Failure

A WARNING as to the dangers of altering or reconstructing old buildings without very careful examination of foundation and structural conditions is afforded by the collapse of the Chicago Club building, 42 years old, as recorded on another page. Apparently the old structure was in excellent condition, yet on a quiet Sunday morning the greater part of the interior collapsed. Failure of corroded beam connections seemed at first to be a probable cause. Careful study, however, revealed the complete failure of the footing of an interior column, a pedestal of rubble stone in lime mortar that had largely disintegrated and a base of concrete that could be dug with a shovel. Furthermore, the footing rested on a bed of soft clay subject to periodical flooding from old and inadequate sewers. Whether the excavation for the foundation piers of the new building alongside caused slipping or settling in the mass of clay under the old building cannot be known, but it is at least a possible factor in the collapse. In spite of careful excavation, voids may be left outside the lining, into which the clay will flow gradually. There is a strong warning in the accident for those who have to deal with old foundations and for those who carry on new construction near them. The foundation builder is rarely without critical problems.

Supply and Demand

FOR a century or more we have been taught to believe that price is fixed by the "law" of supply and demand. The subject of engineering salaries was under discussion recently between two Middle West engineers when this economic law was cited and one of the two men argued that only by decreasing the supply or increasing the demand could the status of the engineer be bettered. In answer the other man asserted that the old law has not controlled the operation of industry for many years. We believe his view has much in its favor. The most successful employers pay a fixed wage to laborers regardless of the number of men available or needed. Commodity prices similarly are stable; safety-razor blades and shredded wheat biscuit cost the consumer the same regardless of the current price of steel or wheat. Carfares are fixed, whether many or few ride and whether the service interval is 5 minutes or 50. What and who in this day is controlled rigorously by the old law of supply and demand? And why, then, should engineering compensation be subject to its sway? Perhaps the engineering profession as a whole can evolve a new basis for salary fixing; perhaps one has already been evolved and simply needs naming or bringing to public notice. At any rate it appears as though the economists' supply-and-demand theory has so many exceptions that one may be pardoned for rejecting the simple application of the law without qualification as not representing modern economics.

Uniform Traffic Signs

COMPARISON of the uniform street traffic signs reported by the American Engineering Council with the standard signs of the Association of State Highway Officials which are now in wide use shows such close agreement that it is pertinent to inquire why the agreement is not made complete. The difference briefly is the use by the Engineering Council of red letters instead of black on the stop signs, and a variation from the shape principle set forth so logically in the state highway officials' system, hereafter called the U. S. system. The latter is a disturbing difference.

Diamond shapes in the U. S. system are for slow signs and always refer to a "condition inherent in the road itself requiring slow speed and caution on the part of the driver." Square signs indicate any condition requiring caution that is "not inherent in the road itself but which is due to contiguous or adjacent conditions." By the U. S. system the "narrow bridge," "viaduct approach" and "street repair" signs would go on diamond "slow" signs, whereas the Engineering Council system puts them on square "caution" signs. It is a small difference, but it could therefore be the more easily reconciled—and the motorist is entitled to the fullest possible uniformity in sign meanings.

In specifying a smaller sign for town use the committee has neglected to recognize that there are so many signs and distractions in cities that the highway markers must be conspicuous, and further that a great mileage of city streets in sparsely built-up areas is in reality country highway. Again, 8 ft. is too high for any sign which must be illuminated by a headlight. Few signs even in cites will have machines parked in front of them, so that non-illuminated signs if placed within headlight range surely would not be obscured. In the round railroad sign the U. S. system calls for two crossbars for two tracks or more. It is a useful symbol and should not be omitted from the Council standard for streets, where there will be far more use for it than in the country.

All octagonal stop and diamond slow signs are required to be illuminated, but nothing is said about illuminating the square caution signs. These give information as important to the driver from the standpoint of possible accident as do the diamond signs. The report departs from the U. S. lettering of black on white and specifies red on white, green on white and blue on white. This is difference without any material advantage, and again the road user has a reason to protest against the change.

Any comment on the traffic-control section of the report must include the statement that while the recommendations are well worked out to suit present-day practice and availability of apparatus, any science so new as traffic control cannot be expected to stand still long. Therefore the simplest statement of principle as to practice, installation and operation is best. In general, altogether too much detail has been attempted by the Council.

Certain practices are condemned. The system of New York City, with its long-cycle, widely separated controlled intersections and speed-inviting synchronized system, comes in that category. A cycle of 40 to 80 seconds is recommended. Safety zones with protected ends and sides raised 5 to 7 in. and those not raised but simply marked off are recommended, but portable

signs or posts set in the pavement at the ends of safety zones are not recommended for general use.

In spite of the criticism of details which seems to be justified the report on the whole is good and will help to better traffic regulation. With it many city officials will from now on have something authoritative as a guide and need not depend entirely on free advice from sales engineers.

Municipal Fund Diversions

DIVERSION of tax funds from the purposes for which they were collected has so long been common in municipal financing that it is refreshing to find a strong attack being made on the bad practice. The case concerned is that of the wheel-tax fund in Chicago, which has just been investigated and studied by an influential local body, the Association of Commerce.

Formerly 99 per cent of the wheel-tax receipts went into street repairs, in accordance with the mandate of the state law which authorizes the imposition of vehicle taxes. In 1928, however, the tax receipts of $4,500,000 were so scattered among different bureaus that less than two-thirds got into street repairs; in fact, more than 15 per cent did not reach the bureau of streets at all!

It is illuminating to learn who were among the beneficiaries of the fund: The city clerk, the city collector, the police department, the bureau of engineering and the bureau of sewers. Manhole and catchbasin covers have been bought with wheel-tax money, bridge approaches have been repaired and traffic signals installed —all out of the vehicle owner's pocket, despite the law.

In its recommendations for reform, the association demands that all these extraneous beneficiaries be lopped off and that only actual street repairs shall be paid for from the fund. Even the item of purchase of street-repair equipment, it considers, should be financed from other revenue than wheel-tax money.

With further view to making the utilization of this fund as efficient as possible, the association proposes a new method of apportioning the money among the city's 50 wards. At present there is much complaint of favoritism in the apportionment. Strictly, the money should be distributed in accordance with the results of condition surveys coupled with traffic volume, but the necessary data for such a procedure are not available. Accordingly, an apportionment based on area, population, mileage and auto registration was devised. Even if not ideal, it would eliminate favoritism and help to place the utilization of the fund on a sound basis.

On present outlook, the finance committee of the city council will accept these recommendations and put them into effect. When this is accomplished, one prominent case of municipal-fund diversion will have been corrected.

But the same city, Chicago, presents another example of unsound method in public-works financing that is even graver. For years the city's water fund has been depleted by transfer to corporate purposes. When the water service made money, the surplus was used on current outside expenses instead of being put into a sinking fund. But six years ago the department began to run behind; now it has a deficit of $11,000,000, and bankers will not buy the warrants. What is still worse, the city's own lawyers doubt the validity of borrowing on water certificates, as has been done to provide current operating expenses.

Something of a crisis has come to exist because of this money juggling. Funds are not available to continue such vital construction work as the Chicago Ave. tunnel (see *Engineering News-Record*, May 26, 1927, p. 860), designed to be completed in three or four years and urgently needed to avert a water famine on the West Side. It is true that the water shortage may be deferred by a vigorous program of installing water meters, but under the best of management the tunnel will be necessary just as soon as it is physically possible to complete it. In order to keep things going during the construction of the tunnel, costly repairs were made on the Chicago Ave. crib to maintain it in service for five years, after which it was to be removed down to lake bed; but the five-year period is now up and the city faces another sizable expenditure to make the old crib hold together and protect it from winter storms and ice until the tunnel is in service.

Unless a prompt and radical cure of the water-fund evil is brought about, then, a grave condition may readily develop. There are not only the current operations and the construction work already begun, such as the water tunnel, but large sums will soon be needed for filter plants if the city is to remain safe. It is high time the water finances of Chicago were stabilized. Here lies a splendid task for a strong technical organization, such as the Western Society of Engineers. Were this body to take up the water-fund situation, remove the incubus of diversion and put the department on a basis of solvency, it would do a lasting service to the community.

San Gabriel an Opportunity

IMAGINATIVE planning buttressed by financial ability is required of the contractors who seek the task of building the San Gabriel dam of the Los Angeles flood-protection works. The mixing and placing to close schedule of 4,000,000 cubic yards of concrete is a stupendous task, both as a problem in construction planning and as an undertaking in contract financing. With the record of the previous call for bids, made before the courts stepped in to halt progress, there is evidence of the ability of a reasonable number of contractors to finance the operation.

What of the construction planning? The question is not put because there is doubt of planning ability to carry the work through, but because this operation offers an opportunity to devise an assemblage of equipment and a construction procedure which will epitomize modern attainment in construction engineering. The volume of work is so great that extreme refinements of plant efficiency may be capitalized, and the value of the work is great enough to warrant large equipment investment. The contractor therefore has an almost unbounded field in which to display his imagination and vision as a practical constructor. It will be interesting to observe the result. The successful solution of the construction problems of San Gabriel will advance prospects for other large structures (Boulder Canyon dam, for example) that now can be studied only in the realm of hypothesis.

Sections and elevations of the San Gabriel dam, a plain gravity structure, do not supply the essential material for the construction planning. To visualize the construction layout as a whole, in three-dimension space, calls for imagination. When the bids are opened next week it is to be hoped that behind the low bid there will be a vivid imagination plus a most careful analysis of the facts and conditions.

Long Concrete Trestle of Precast Units

Rapid Construction of 7-Mile Bridge Across San Francisco Bay Made Possible by Use of Precast Piles, Slabs and Rails

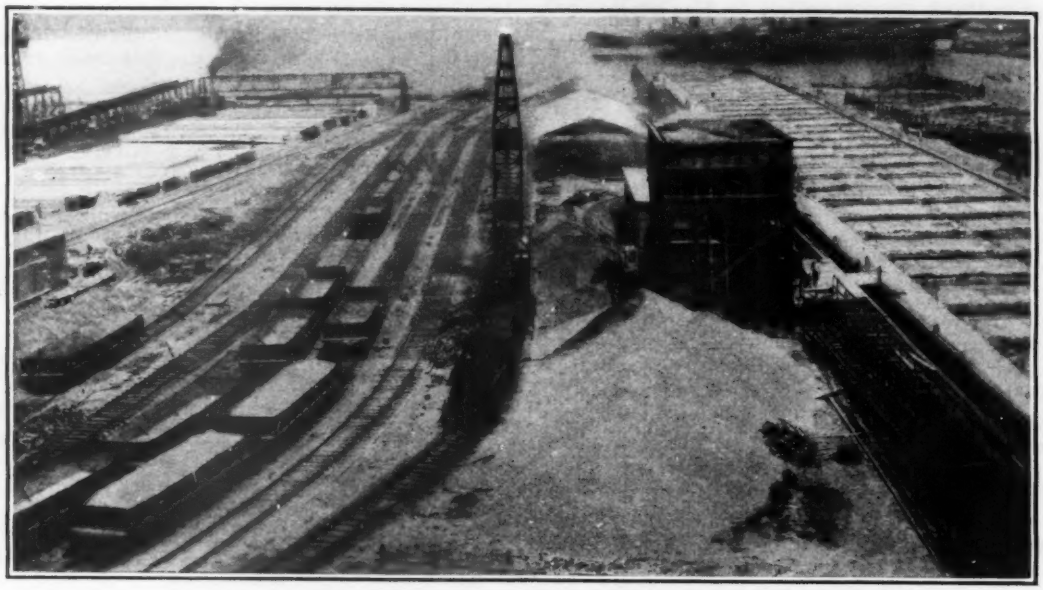

FIG. 1—VIEW OF CASTING YARD, SAN FRANCISCO BAY BRIDGE

SAN FRANCISCO BAY is being spanned by the longest highway bridge yet constructed, 7.1 miles, which, except for five steel truss spans, is being built entirely of precast concrete units cast some 20 miles from the bridge site. A well-equipped casting yard turning out units with the scheduled precision of a steel-fabricating shop, a four-lead piledriver and a 100-ton floating derrick setting slabs are breaking all construction records for speed in concrete trestle building.

The structure, with its western terminus at San Mateo, 20 miles south of San Francisco, and its eastern end at Mount Eden, 14 miles south of Oakland, will cost $7,500,000. The bridge is for vehicular traffic only, has a width of 27 ft. between curbs and its height will be 17 ft. above low water except in the channel crossing and approaches. The bridge occupies the site designated No. 2 on the San Francisco Bay bridge map published in *Engineering News-Record*, July 30, 1925, p. 178. In its general design the structure is somewhat similar to the Lake Pontchartrain bridge described in *Engineering News-Record*, March 29, 1928, p. 502, but involves novel features in the casting yard and in erection methods.

The trestle design consists of four-pile bents of 116 35-ft. bays and 1,054 30-ft. bays, depending on the water depth, each bay spanned by two precast deck slabs identical for each half of roadway. These deck slabs consist of a 10-in. floor slab cast integral with two longitudinal arched beams, 1 ft. 6½ in. wide and resting on concrete caps, as shown in Fig. 8. The caps are poured in place. Expansion joints occur at every fifth bent, which are of six piles, the four interior piles battered 1:6 longitudinally, two sloping each way. The curbing and railing are precast sections except the rail posts, which are poured in place.

In addition to the 7.1 miles of bridge proper, 1.75 miles of approach is being constructed at the east end and a 3-mile approach on the west end. The west approach includes a short bridge over Seal Creek which was built by the same concrete pile-and-slab method used in the main structure. Both of the approaches consist of dredged fills to be paved with concrete.

Casting Yard—The yard in which all precast units are poured was laid out on the east bay shore 12 miles north of the bridge at a point convenient to rail and water transportation. Towing distance, however, is 20 miles from the casting yard to the bridge site. The yard is in two divisions, each complete with its transportation system, material storage and concrete mixing plant (Fig. 2). The pile-casting division has a platform 120 ft. wide by 325 ft. long on which 200 pile forms can be set up. In the other division is a permanent assembly of forms of deck slabs arranged in a continuous double line 1,528 ft. long. Railing and curb units, as well as a few other precast shapes, are also built up near the deck yard, served by a separate mixing plant.

Sand and gravel are brought in 35 miles by rail at the rate of 35 carloads a day. These cars are unloaded by locomotive cranes direct to the mixing plant bunkers, which have a capacity of 100 cu.yd. each. About 800 cu.yd. of material is kept stored near by to avoid any plant tie-up. Two 1-cu.yd. mixers are installed in each mixing plant and all concrete is mixed 1½ minutes. Delivery to the form is by hand buggies throughout both yards (Fig. 5), except that in the slab yard the length of buggy deliveries is cut down by two auxiliary hoppers serving more remote parts of the yard, these hoppers being supplied by cable-operated hopper cars.

Both pile- and deck-casting yards are on soft ground

with the water table less than 10 ft. below the surface. Bearing for the forms was secured by driving 2x4-in. stakes into the ground, the spacing varying with the load concentration, but averaging 2 ft. In the slab yard 55,000 stakes were driven, while 13,000 were used under the pile platform. Each stake was first driven down to a firm bearing, the penetration ranging from 1 to 4 ft., after which a 2x4-in. "scab" was nailed crosswise to the stake at the ground level. Test loads on these stakes showed that each one would support 400 lb. without settlement, while in casting operations they are subject to a load of about 200 lb. each.

The schedule of work in the pile yard is arranged so that each operation will advance progressively down the length of the yard. On this basis the work of preparing a form for the next pour proceeds as fast as the piles are lifted. The forms for each pile consist of two side panels nailed to the platform and held in place along the upper edge by a spacer or cover board the overhanging edges of which are beveled to form the bevels of two adjoining piles. With oiling and care between pours, side panels serve for 30 or more pours, whereas the beveled cover board, which has sharp edges and is subject to much wear, has to be renewed every fourth pour. The concrete mix for the piles is 1 : 2.08 : 2.8 with a water-cement ratio of 0.65. Two per cent of diatomaceous silica is used in this mix and tests show compressive strengths of 3,000 and 4,300 lb. per sq.in. in 7 and 28 days, respectively.

Spanning the pile-casting platform is a 50-ton gantry crane with a span of 125 ft., running on a track 1,200 ft. long. This gantry picks up reinforcing cages, two at a time, in the steel yard at the shore end of the platform and delivers them to the forms. It also lifts the finished piles from their forms and conveys them to the storage space at the bay end of the yard, whence it later loads them on barges. Up to 77 ft. in length the piles are designed for three-point support, four-point supports being used on greater lengths. The maximum pile length is 105 ft.

About 5,000 piles are being cast, which will require a total of 26,200 cu.yd. of concrete. About 3,300 of the piles are 16 in. square in lengths between 45 and 65 ft. The remaining piles are 18 and 24 in. square.

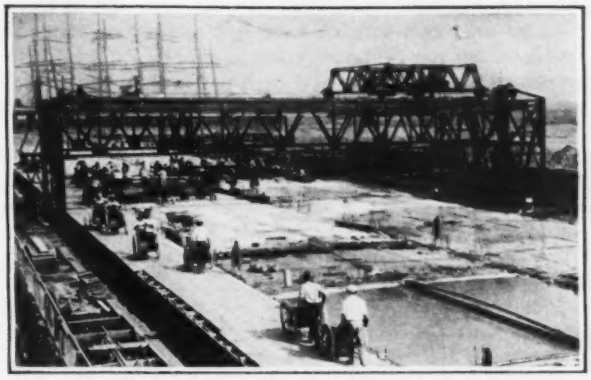

FIG. 3—SLAB-CASTING YARD AND GANTRY CRANE

There are also 94 batter piles which have a 20x26-in. section.

In the yard the piles are handled by 1-in. T-bolts screwed into ½-in. plates, 6 in. square, embedded in the concrete below the center line. These bolts, well greased, are placed before the concrete is poured and are given half a turn a few hours after pouring to prevent bond. After delivery to the storage yard the bolts are removed so that the piles may be stacked up three or four layers high. The bolts are screwed back in place when the piles are to be lifted to the barge and are finally removed after the pile is on the barge. The bolt holes are then plugged with grout. At the driver, slings placed at the T-bolt points are used in picking up the piles and as long as they are in a horizontal position they are kept right side up in accord with the distribution of reinforcing steel.

In both pile and slab yard freshly poured concrete is covered with burlap and kept wet with sprinklers. Moist covering is kept over all precast units until they are removed from the yard. The piles are left in their forms seven days and usually go out to the driver 28 days after pouring. The deck slabs are loaded on barges not less than eleven days after pouring.

Deck Slab Casting—The deck slab-yard platform is 70 ft. wide and its 1,528-ft. length includes 84 bays for the 30-ft. slabs and fifteen bays for the 35-ft. slabs.

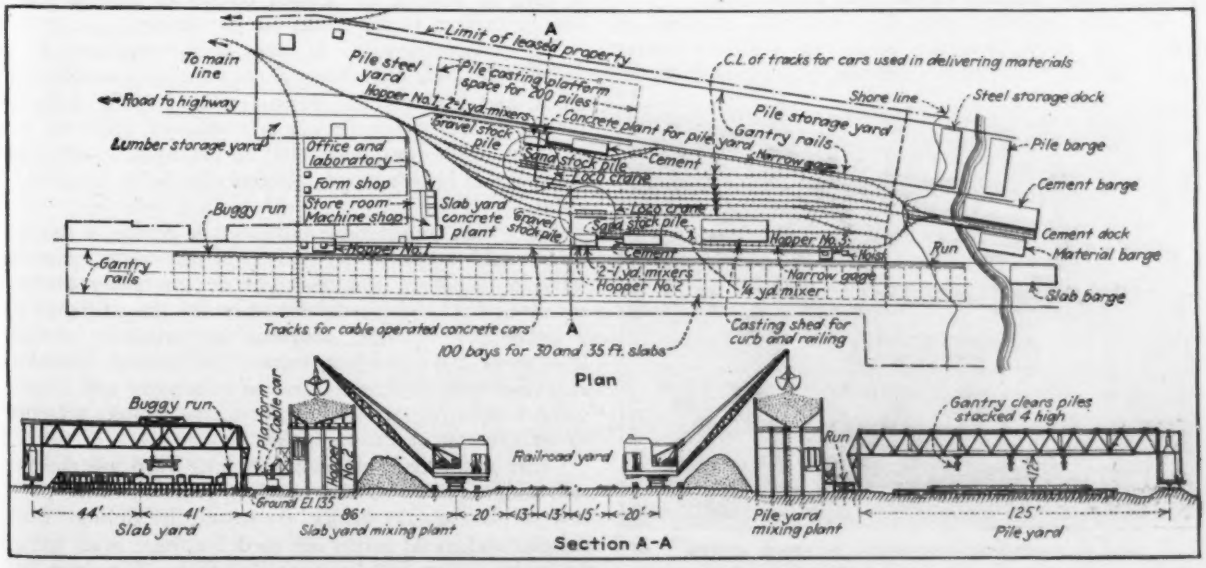

FIG. 2—PLAN AND SECTION OF STORAGE AND CASTING YARD

The forms are set up so that the slabs are cast in pairs, side by side, two to each bay, just as they are later to be placed on the bridge. A longitudinal ½-in. steel plate separates the two slabs, and each pair of slabs is poured as a single unit. The short slabs weigh 46 tons and the long slabs 55 tons each.

The bridge has one 6 deg. curve 472 ft. long on which the pile bents are located on radial lines. The deck slabs for these bays have straight sides with ends in radial instead of parallel planes. The slabs for the curve are all alike and are cast in forms built solely for this special shape.

When the first set of slabs was removed from the forms, there was extensive damage in the displacement and ripping apart of the formwork clinging to the concrete. This fault was corrected by widening the tops of the longitudinal arch beams and arranging one side of each beam form so that it can be loosened and dropped down, as shown in Fig. 4, before the slab is removed. The forms are also tied down with ½-in. rods to prevent displacement during the lifting operation.

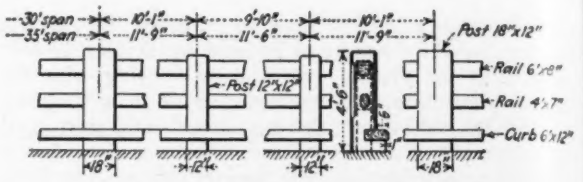

FIG. 6—TYPICAL RAILING ASSEMBLY
Rail and curb units are precast. Posts poured in place.

a structural steel lifting frame about the same size as the slab, and from each of its four corners a flat hook is suspended from a sliding support. The position of the hooks can be adjusted to the different slab lengths. The slab design is such that lifting can be done safely at the four corners by hooks or jacks placed not more than 2 ft. from the inside face of the longitudinal beams. Over the central part of each slab end a heavy red paint mark is used to indicate the danger zone under which supports may not be used in handling or placing the slabs (Fig. 11). On either side of this red mark

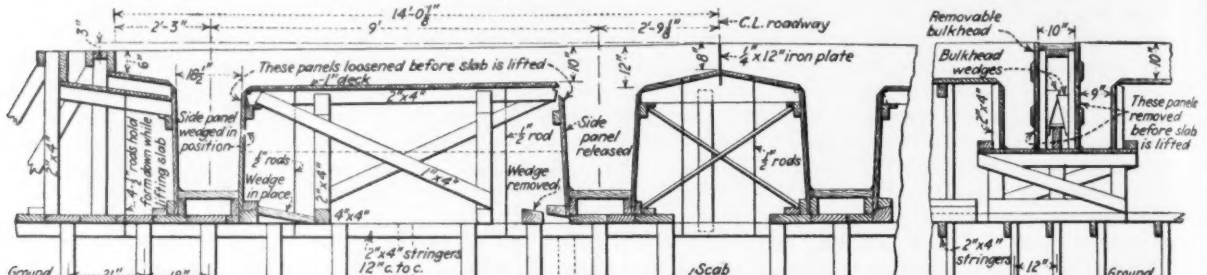

FIG. 4—SECTIONS OF SLAB FORMS

The forms are being used fourteen or fifteen times before renewal is necessary. As often as necessary all vertical faces are sanded down and rubbed with plaster of paris, followed by a coat of shellac. Before each pour the entire form is coated with an oil compound consisting of five parts by volume of form oil and one part of ordinary cup grease. This was found best after trying a large number of oils and compounds.

The slabs are lifted from the forms and deposited on barges for delivery to the bridge by a 75-ton gantry crane with an 85-ft. span (Fig. 3). This gantry carries

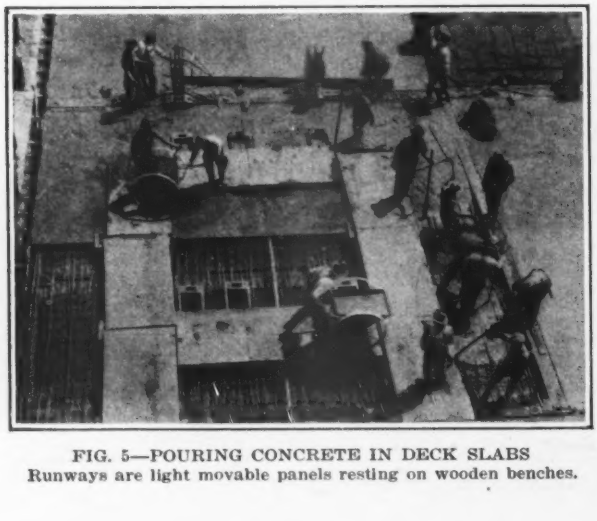

FIG. 5—POURING CONCRETE IN DECK SLABS
Runways are light movable panels resting on wooden benches.

there is ample space for the jacks and blocks used as temporary supports while setting the slabs.

Barges for the deck slabs, moored between the rails of the gantry track at the bay end of the yard, are loaded with six slabs, or about 300 tons per barge. A 12-hp. outboard motor in a flat-bottom skiff is very convenient for maneuvering these barges in the slip and is used in placing the loaded barges in tandem ready for the tugboat to take them out on the bay.

The concrete used in the deck structure is a 1:2.8:4.11 mix, containing 3 per cent of diatomaceous silica, and has a water cement ratio of 0.85. Laboratory tests show compressive strengths of 1,900 lb. per sq.in. in seven days, and 3,300 lb. per sq.in. in 28 days. A total of 51,000 cu.yd. of concrete is to be cast in slabs.

There was considerable difficulty in getting a templet that would satisfactorily finish off the slabs, particularly in the 35-ft. lengths. The design finally evolved consists of a 1x6-in. cedar board on the flat, stiffened by a cedar 2x4 on edge, which is supported by a truss built up of 2x4's and ½-in. bolts. This templet is worked very well with three men, one on either end and a third using a light line at right angles to the templet attached to an eye-bolt at the midpoint.

Other units made up in the casting yard are the top rail, middle rail and curbs, which, together with the posts cast in place on the bridge, constitute the railing. Both wooden and metal forms are used for these small units; the metal forms involve a much greater first cost but

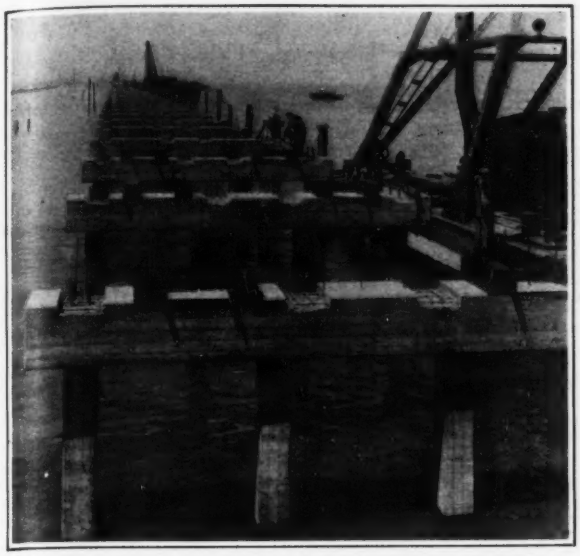

FIG. 7—BENTS CAPPED AND READY FOR SLABS

greatly decrease the amount of handwork required and give a somewhat smoother finish. The wooden forms were built when it was found that deliveries on a full supply of steel forms would cause delay. The wooden forms are sanded down, rubbed with plaster of paris and shellacked after every fifth pour. They require to have the bevel finished by hand after pouring, whereas the metal forms carry a bevel fillet along the upper edge of the steel plates that separate adjacent sections.

The force in the casting yard totals about 275 men and the average output is 200 piles and 54 deck slabs per week on the basis of one eight-hour shift daily.

Piledriving—Because all the erection work was to be done by floating equipment, the first work at the site was to dredge a channel deep enough to float the pile-driver and the derrick barge. In doing this a total of 1,400,000 cu.yd. of material was dredged out of the shoal waters on both sides of the bay.

Before any piles were driven in the bridge concrete test piles were put down along one side of the dredged channel 200 to 500 ft. apart. The results in driving these piles gave data on which to estimate the length of the permanent piles required for each bent. Some of these test piles were also used on load tests. For this purpose wooden piles were driven in a circle around the test pile and a steel tank holding 100 tons of water was placed on the pile cluster. During the test the full load of the tank was transferred by jacks to the concrete pile in the center. Concrete piles that were going down at the rate of ½ in. per blow when driving stopped were found to support 100 tons without appreciable settlement.

More than 100 test piles were used, of which about 70 per cent were made with cement of high alumina content. Toward the end of the test pile work, however, it was found that piles could be made of ordinary cement which could be taken from the forms four days after pouring and driven on the fifth day. In these special piles the usual mix was used except that an extra sack of cement per cubic yard was added and the batch was mixed three minutes with water sufficient to give a 2-in. slump. A considerable number of piles so made and kept thoroughly wet for four days were then taken to the bridge and on the fifth day were successfully driven. Some of these were driven and pulled twice without developing any cracks.

Piledriving was done by a driver equipped with four leads and two steam hammers. A derrick boom above the leads moved the hammers from one lead to another and lifted the piles into place from the barge alongside. Driving proceeded at the rate of about 32 piles per shift. Each pile was lined up by a transit when put in the leads before it was allowed to sink and again before driving commenced. The leads on the river were so mounted that they could be shifted on the barge in two directions by steam-driven gearing, thus facilitating speedy adjustment to exact position. The hammers have a 36-in. stroke and strike a 5,000-lb. blow. Piledriving commenced April 3, 1928, and has just been finished, more than 5,000 piles having been driven in seven months.

Each pile was cast in the length estimated to be right for the location to which it was assigned, and reinforcing left projecting to make a bond with the cap. When penetration under the hammer was less than 1 ft. for 70 blows, no further driving was done and that part of the pile above grade was cut away. If a pile drove at a rate of more than ½ in. per blow after it was down to grade, it was pulled and a longer one substituted.

Before lifting each pile from the barge a steel plate containing holes that pass the reinforcing bars was slipped on over the upper end of the projecting rods, and a collar was then fastened to each rod above the plate with a setscrew. To a shackle on top of this plate a line was fastened before the pile was lifted from the

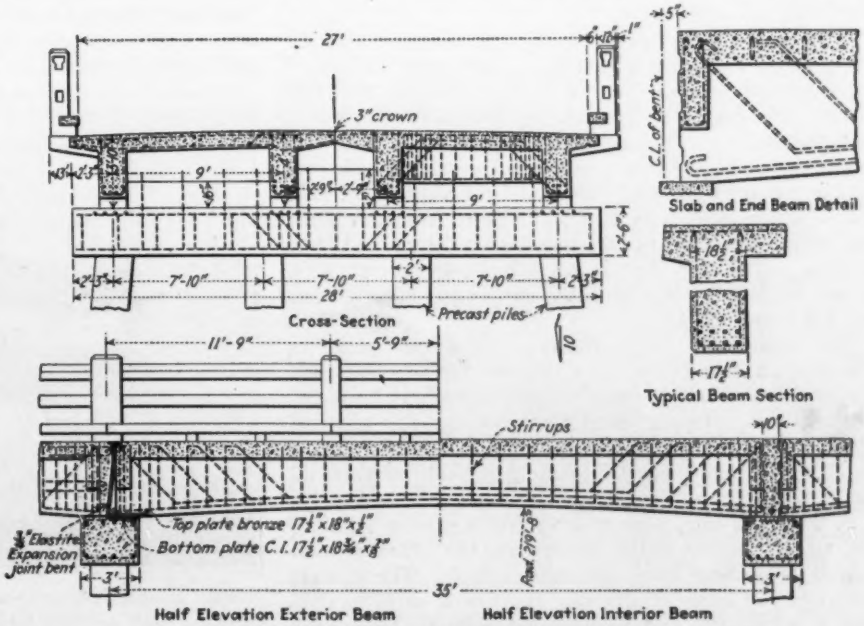

FIG. 8—DETAILS OF CONCRETE TRESTLE

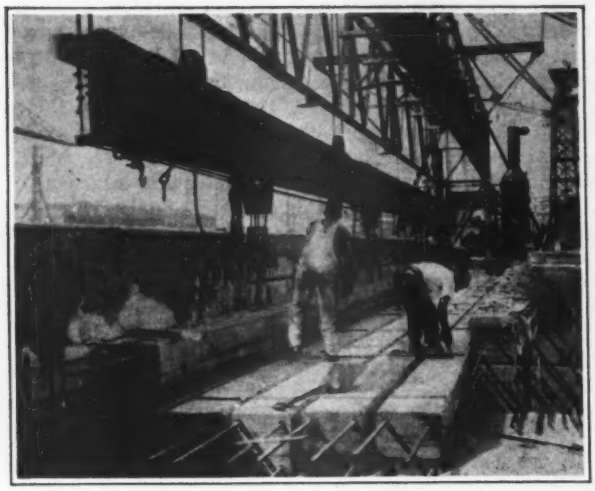

FIG. 9—GANTRY CRANE STACKING PILES FOR STORAGE

barge by the slings. As the pile was swung toward the lead, it was tilted so that ultimately the line to the plates in the upper end carried the load. The slings were then released and the pile set in the leads by the single line from the top. This line was not removed until the pile was allowed to sink and was ready for the hammer.

In deep water, particularly where the 35-ft. bays are used, it is necessary to fasten the piles together temporarily to prevent excessive swaying under wave action and tidal current before the superstructure is placed. The fastening consists of 4x8-in. struts bolted around each bay as a framework and double steel cables placed diagonally which are tightened up by twisting.

Setting Deck Slabs—Following the driver comes the crew that bolts, to the four piles of each bent, formwork in which the cap is poured from a floating concrete plant. The bent is then ready for the deck slabs, which are placed by a 100-ton derrick barge. The slabs are rested first on the four 12x12-in. wooden blocks set on the cap near the four corners of the slabs (Fig. 12). Ball-bearing jacks then take the weight from the block and shift the slabs to exact position as determined by a transit. The load then is transferred to screw jacks, which are left in place until the supporting concrete has set for seven days.

The position in which the deck slabs are placed on the caps leaves a 10-in. space between the adjacent ends and each slab has two loops of reinforcing steel projecting into this opening. Steel from the cap also projects upward into this gap, and with additional bars inserted as a tie, concrete poured into the gap binds all parts of the structure firmly together.

A third and final pour in the erection process includes the railing posts, which are poured in place around dowels projecting from the slab surface. The precast curb and rail units project into the forms so as to provide a substantial and well-bonded railing. Details of the railing are shown in Fig. 6.

FIG. 10—FINISHED SECTION OF BRIDGE

Expansion joints every fifth slab consist of ¾-in. asphaltic compound between vertical faces, through which no reinforcing steel projects. At these joints the weight of the slab is concentrated on 18 in. square cast-bronze plates embedded in the four corners of the unit and resting upon cast-iron plates of the same size embedded in the cap beneath.

Fast Construction Schedule—Work was started on the bridge in December, 1927, under a contract calling for completion June 16, 1929. Present indications are that the work will be finished well ahead of schedule. During the month of July and using one eight-hour shift 7,300 ft. of the bridge deck was placed. The best single day's progress was made late in August, when one shift placed 510 ft. of the deck.

A feature of the job that has made possible excellent co-ordination of erection progress and casting yard schedule was the installation of a radio telephone communication system. Because there is no space for storing slabs at the casting yard, these units cannot be taken from the forms until empty barges are ready to receive them. Due to delays in communication, time was often lost in the casting yard because the time of the barge arrival was not known in advance. Since the installation of radio the yard is always in communication with the derrick barge and hence can plan the schedule of yard crews to fit exactly with barge movements.

The bridge is being constructed by the San Francisco Bay Toll-Bridge Company. Waddell & Hardesty, New York, are consulting engineers. A. W. Deuel is resident engineer in charge, and F. A. Savage and C. P. Moss are field engineers. Contract for the construction of the bridge as a whole is held by the Raymond Concrete Pile Company, O. C. Struthers, Pacific Coast district manager; R. A. McMenimen, works manager; James V. Brannigan, superintendent on the bridge; T. V. Moore, assistant to the works

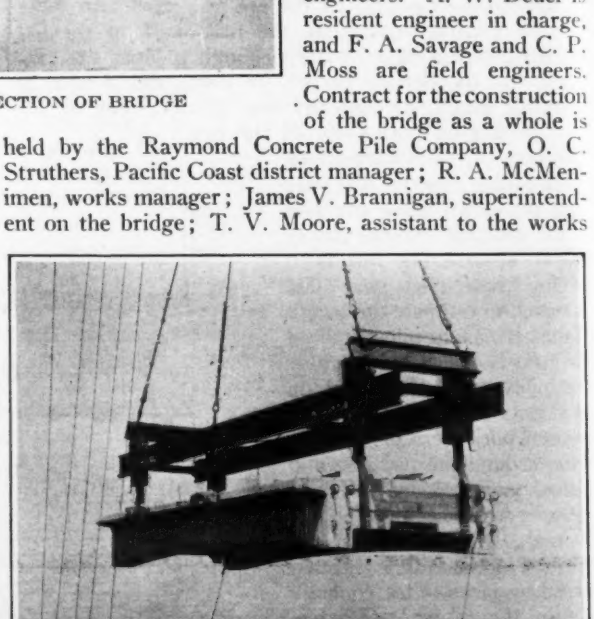

FIG. 11—LIFTING FRAME USED IN HOISTING SLABS FROM BARGE TO BRIDGE

Painted band on end of slab marks area unsafe for placing lifting hooks or jacks.

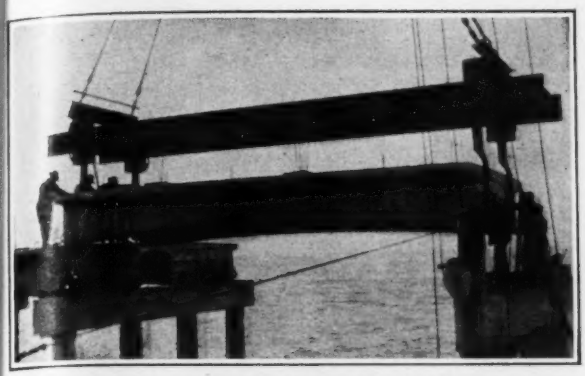

FIG. 12—PLACING A 30-FT. DECK SLAB
The timber blocks shown on the cap support the slabs until they are jacked into final position.

manager, and W. X. Hull, superintendent of the casting yards. The Haviside Barge Company assisted in placing deck slabs. A sub-contract for the channel span foundation is held by the Foundation Company, and the Virginia Bridge & Iron Company has a sub-contract for the five steel spans.

Sedimentation Study in the Mississippi River

Mechanical Analysis of 235 Samples of Sediment and Suspended Matter Collected Over a Distance of 500 Miles

A COMPREHENSIVE study of the sediments in the Mississippi River and the phenomenon surrounding their carriage and deposition is being carried on by Dr. A. C. Trowbridge, professor of the department of geology, State University of Iowa. One unit of that study, from Davenport to Cairo, is reported upon by Dr. Alvin L. Lugn, department of geology, University of Nebraska, in a 104-page monograph issued by Augustana College, Rock Island, Ill. Mechanical analyses of 235 samples of sediment and suspended matter collected in 1925 and 1926 over a distance of 500 miles were made.

Sediment sizes range from small boulders to colloid, and there seems to be no place when the river is not competent, at times, to transport the largest fragments of material supplied to it by the tributary streams. As to volume moved, greater quantities of coarse débris are brought in than the river can completely remove, so that there seems to be a net gain in the quantity of flood-plain deposits in some portions of the river's course. This aggrading action is regarded as only temporary, for the section of the river now is only temporarily at grade over most of the distance studied. The explanation is offered that the river is cutting in the rock gorges and scours the bedrock clean, while at some distance from each gorge is an old filled valley with a former riverbed at a lower level than at present.

The most important factor which keeps sediment suspended and in motion downstream is the turbulence of the water—that is, the number and strength of eddy currents, whirls, boils, etc. It is believed that the effectiveness of this turbulence in maintaining sediment in suspension varies in the same ratio as competency is supposed to vary with average forward velocity of the current. Thus, if competency varies as the fifth or sixth power of forward velocity, it does so because the effectiveness of turbulence, as above understood, varies in the same ratio. Current velocity in the Mississippi River is largely dependent on volume of water. Gradient is a minor factor; width and depth of channel affect velocity in a few places. Velocity and the configuration of the riverbed determine the number and strength of eddy currents, whirls, boils, etc., which collectively make turbulence. It is evident, then, that the river's maximum capacity and greatest competency are attained only during times of high water and then only for periods of short duration, since the volume of water is the most important factor affecting the competency of the river.

Under some conditions, not as yet fully analyzed, quantities of sediment are maintained in a state of semi-suspension on the bottom of the river. This phenomenon was observed in shallow water near the banks at many places in the Mississippi above the mouth of the Missouri River. In the Mississippi River, above the mouth of Missouri River, such semi-suspended layers of mud are common and never more than a few inches thick. All such mud contains a considerable amount of the fine sand and coarse silt grades in addition to much clay.

Six general types of Mississippi River sediment are distinguishable by mechanical analysis. Sorting is believed to be the best basis for distinguishing types, for if competency is increased by an increase in the volume of water or in a narrower and deeper part of the channel, the kind of sorting in most cases remains the same, but the average coarseness of the sediment may change.

An explanation of the mode of formation of only one type, pudding sand, is given, since it was developed after observation on the stream table in the laboratory.

If all grades of material are available, under some sets of conditions not fully understood the current selects and sorts out of the heterogeneous supply certain grades, the chief ingredients and the adjacent coarse and fine admixtures. This material is then transported along the bed of the river, largely as bottom load, by rolling, gliding and saltation. The great mass of this "principal load" (channel or well-sorted type) moves downstream more or less as a large unit, usually spreading and lengthening out as it migrates. The pebbles that are too large to be moved under the prevailing conditions remain at the source as a lag concentrate. The pebbles that range in size from about the third to the fifth grade above the maximum grade of the principal load seem to be transported by rolling on the bottom with greater facility and at much greater speeds than the material of the principal load, even though the latter is of much finer texture. These pebbles are rolled farther and faster and are carried down the river beyond the bar of principal load of finer textures and do not become incorporated into deposits of this material. With every kind of principal load there seems to be one grade of pebbles, just smaller than the smallest size left in lag concentrate, that are small enough to be rolled along the bottom with the principal load but not small enough to be carried beyond it, and these are stopped on the lee or downstream end of deposits of channel or well-sorted types of sediment and become incorporated into them, thus forming the pudding sand type of sediment. As a large and long bar of this material, principal load and pudding pebbles, migrates downstream, the pebbles are re-excavated at the stoss or upstream end of the bar, rolled over the bar and redeposited at the lower end.

Foundation Caused Collapse of Old Chicago Club Building

Interior Column Punched Through Masonry Footing 42 Years Old and Dropped 16-Ft.—Five Floors Fell

By John O. Merrill
Of Granger & Bollenbacher, Architects, Chicago

An investigation of the cause of the failure on June 17 of a portion of the old five-story building of the Chicago Club, Michigan Ave. and Van Buren St., Chicago, disclosed foundation conditions which made necessary the wrecking of the structure and the substitution of an entire new building in place of the contemplated alteration work. This accident was noted in *Engineering News-Record* of June 28, 1928, p. 1020.

In July, 1927, construction was started on a building program which provided for the erection of a ten-story annex and the remodeling of the old building. The annex, a steel-frame building resting on caissons sunk

FIG. 1—FAILURE OF CHICAGO CLUB BUILDING
In the five floors, two bays each way from the corner collapsed, leaving walls and roof standing. New club annex at right.

to rock, was completed in May, 1928, and the club quarters were then transferred to the new building, the old structure being vacated for the alteration work. At the time of the failure this work was barely started and the engineers were convinced that it did not contribute to the failure, no structural parts having been disturbed in the vicinity of the collapsed portion.

The old five-story building, 80x100 ft. in plan, was erected in 1886, and was constructed with heavy load-bearing exterior walls, cast-iron interior columns and steel girders and beams supporting flat tile floor arches. Wall piers and interior columns were spaced about 25 ft. in both directions. All steel and iron members were fireproofed with tile, and, in general, the superstructure of the building was of an unusually modern type considering the time at which it was erected.

FIG. 2—TOP OF FOOTING THAT FAILED
The column is a first-story column that has gone through the basement footing.

The failure, which occurred on Sunday, June 17, about 5 p. m., consisted of the complete collapse of five floors at the northeast corner of the building, involving an area about 50 ft. square or two bays in each direction. The exterior walls remained intact, but the interior column at the center of the area collapsed with the floors. For some reason the roof did not fall, although it was constructed with steel rafters supported on girders, which in turn were supported by the collapsed column. Fortunately the failure caused no loss of life, the club quarters having been transferred a month previously and no workmen being in the building on Sunday. Fig. 1 shows the old building two days after the failure, with the new annex at the right, on Van

FIG. 3—INTERIOR OF BUILDING AFTER FLOORS FELL

Buren St. The collapsed floor area extends two bays along each street from the corner.

It was decided to proceed at once with the removal of the wreckage and at the same time to make a thorough study of the material as it was removed in order to determine, if possible, the cause of the failure. The direction of certain grooves cut in the exterior walls by falling beams and the general position of structural members after the collapse indicated that the initial point of failure was at an interior column. Fig. 3 is a general view of the interior looking southeast. As the removal of debris proceeded it seemed apparent that the basement section of the collapsed column was left standing on its footing. The removal of this section of column, however, disclosed the astonishing fact that it was the first-story column section, and that the basement section had punched through the entire footing and was resting with its cap level with the top of the footing and its base about 16 ft. down in the ground. Fig. 2 shows the condition at top of footing, with first-story column in place. In Fig. 5 this column has been removed, exposing the cap of the basement column which was below it.

The column footing (Fig. 4) consisted of a thin cast-iron bearing slab supported on a single piece of dimension stone, below which the load was spread to an area 10 ft. square by a pyramid of rubble masonry with a plain concrete slab at the bottom. The bearing soil at this footing was a soft wet clay, this material being typical for the top 30 ft. of soil in this part of the city. The block in which the Chicago Club is located is mainly occupied by heavy buildings which were erected before the introduction of caisson foundations and consequently are supported on spread footings. It was discovered that although the exterior of the masonry pyramid appeared in good condition, the interior mass was built of comparatively small stone laid with lime mortar. The mortar was found to have practically no strength, most of it having been washed away by the action of water over a period of 42 years. The concrete slab below had little strength and could easily be broken with a shovel.

These conditions point to a footing failure. The superstructure of the building was in fair condition, with the exception of the beam connection angles, which were of iron and were badly corroded in many instances. The foundation condition, however, seems to be a more probable cause of the failure. It is the writer's opinion that (1) the gradual disintegration at the center of the rubble masonry reached a point where the support was almost entirely withdrawn from the center of the dimension stone cap; (2) the cast-iron bearing slab was obviously inadequate, resulting in increasing stresses in the dimension-stone cap, which ultimately fractured and allowed the column to drive down through the soft masonry below. This conclusion is further substantiated by the fact that the building was unoccupied on the day of the failure

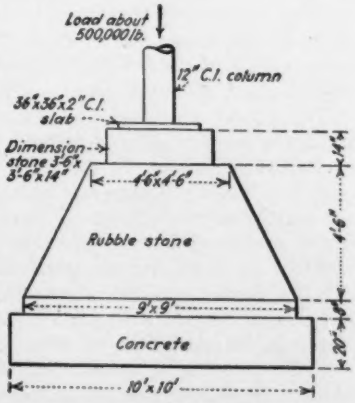

FIG. 4—THE FOOTING THAT FAILED

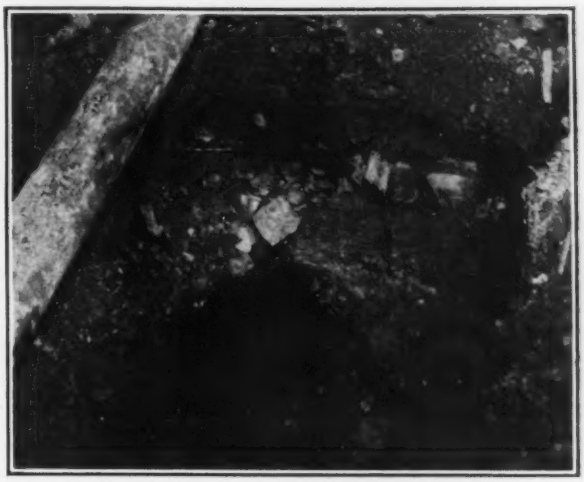

FIG. 5—BASEMENT COLUMN FOUND BELOW FOOTING
Cap of basement column exposed by removal of first-story Column shown in Fig. 2.

and was entirely free of vibrations incident to the alteration operations. However, an unusually heavy rainstorm a few hours before the collapse flooded the basement.

An investigation of the exterior wall foundations disclosed a similar disintegrated condition and resulted in the decision to wreck the old building completely and replace it with a modern ten-story structure similar to the annex. Granger & Bollenbacher are the architects for the new building and for the annex; the E. F. Scheidenhelm Company has the general contract for both units. The investigation of the failure was conducted jointly by Stanley Field, representing the Chicago Club; Christian Paschen, city building commissioner; Lieberman & Hein, structural engineers; J. C. Bollenbacher and the writer, representing the architects; and the general contractor.

New Formula for Wood Column Strength

A new formula for computing the strength of wooden columns of intermediate length has been worked out by the Forest Products Laboratory, U. S. Forest Service, Madison, Wis. The application of the formula to structural timbers was demonstrated in a test of Southern yellow pine and Douglas fir timbers provided by the National Lumber Manufacturers' Association. It is claimed to be much more accurate than present formulas and therefore permits factors of safety to be reduced accordingly. The new formula is as follows:

$$\frac{P}{A} = S\left[1 - \tfrac{1}{3}\left(\frac{L}{Kd}\right)^4\right]$$

in which P equals the load in pounds, A equals the cross-sectional area in square inches, S equals the maximum crushing stress, L equals the unsupported length in inches, K is a constant depending on modulus of elasticity and crushing strength for a given species, grade and condition of service, and d equals the least dimension in inches. Since both stiffness and crushing strength enter into calculations of strength of intermediate length columns, values for both these properties must be known in order to determine the necessary size. To accompany the formula tables have been prepared which give values for the safe crushing stress, modulus of elasticity and also for K for most of the commercial species of lumber. In using the formula it ordinarily should be rearranged and solved for the least dimension.

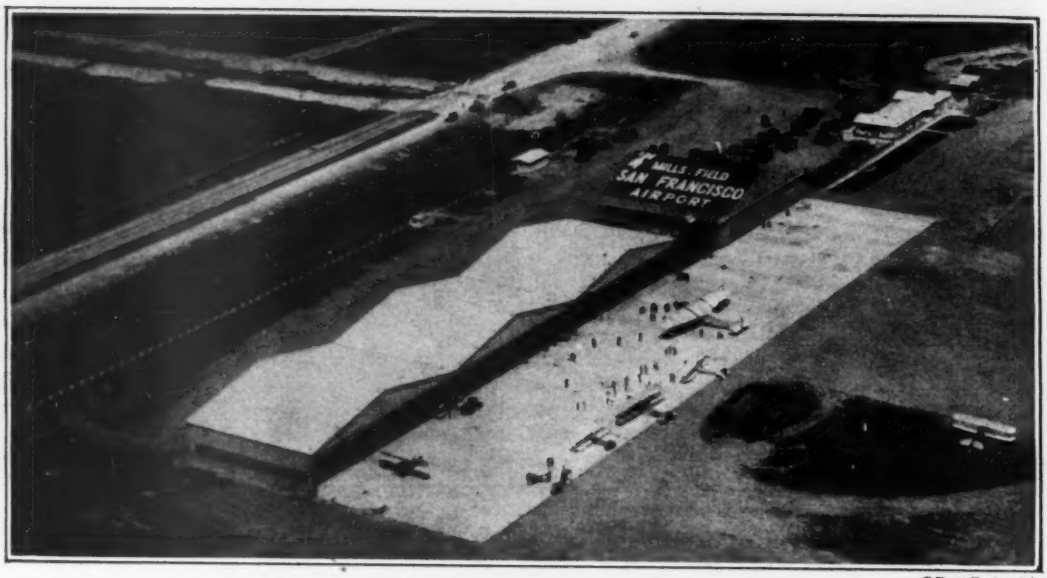

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FIG. 1—MUNICIPAL AIRPORT BUILDINGS AT MILLS FIELD
Bay Shore highway parallels field. From left to right hangar 2, hangar 1 and administration building. Drainage ditch between road and buildings.

Temporary Development of San Francisco Airport

Meteorological Data Lacking, the Structures Were Built for Easy Removal—Being Below High Tide, the Site Is Leveed and Supplied With Automatic Drain Pumps

By George D. Burr

City Traffic Engineer, Formerly Airport Engineer, Bureau of Engineering, San Francisco, Calif.

THIS ARTICLE is to be commended to those cities that are rushing into the expenditure of huge sums of money for airports without first making a very thorough analysis of all available sites. San Francisco not only chose the Mills Field location after an engineering analysis of nine available sites but developed it only in a temporary manner until a meteorological examination proved that air conditions were the best. The field's equipment and layout are typical of other municipal airports. Selection, design and construction of Mills Field were in the hands of San Francisco's city engineer. —EDITOR.

SAN FRANCISCO is unique in the method of selection and improvement of its municipal airport. After a careful investigation of all possible available locations over a wide range of distances, the one that seemed most advantageous from the physical standpoint was selected as a temporary site while a meteorological investigation was being conducted and the field for the permanent airport prepared. Fortunately this meteorological investigation checked the original location as being the most suitable, all things considered.

In July, 1926, $100,000 was made available for airport purposes and a study by the bureau of engineering was authorized looking toward the acquisition of a site. The most promising sites were examined in detail. Rough surveys were made and estimates prepared for the construction of an airport at these points. The basic unit used for comparison was a level, well-drained tract of land, 3,000x5,000 ft. in size, with clear approaches and with the longer axis in the direction of the prevailing wind. The existence of adjacent means of transportation and the possibility of the development of a seaplane base were taken into consideration. As the commercial possibilities of aircraft are primarily contingent on the ability of air transportation to save time, the "time distance," with available means of travel, from each side to the commercial center of the city was included as part of the estimate.

Another important factor is the meteorological condition. To be successful an airport must be capable of as nearly constant use as possible. Fog is an extremely serious handicap. Close under the leeward side of hills down-drafts and turbulent air can be expected, which make air navigation hazardous. These aerological conditions were known in a general way, but exact data were lacking, as the only two important Weather Bureaus stations in the vicinity were located on top of a tall building in the center of the financial district of San Francisco and at San Jose, 50 miles south.

The report submitted by the city engineer included estimates on nine sites, scattered from the Golden Gate to Beresford, about 21 miles by highway south of the center of San Francisco, and included an estimate on one site on the eastern shore of San Francisco Bay. The report recommended the selection of the site now known as Mills Field as the one presenting the most apparent advantages, but qualified the recommendation to the extent that aerological information was lacking and it would therefore be desirable to acquire this site only temporarily, pending a meteorological investigation of the whole area to ascertain the unknown factors.

The Board of Supervisors, the legislative branch of the

municipal government, acting upon the recommendation of the city engineer, adopted Mills Field as the temporary location. It authorized $10,000 for a meteorological investigation and appropriated funds for the construction of the necessary temporary development of the field. To date approximately $225,000 has been expended in connection with the municipal airport, including the meterological investigation, construction, operation and maintenance.

All improvements that have been constructed have been classified as temporary, pending the selection and construction of the permanent field. On May 21, 1928, Mills Field was adopted as the permanent airport location, as the results of the meteorological investigation had vindicated the judgment of the engineer in his tentative selection of a site. The present buildings and field will be used for a period of about three to five years until supplanted by permanent ones on the same land. The cost of the permanent field and improvements is preliminarily estimated at $2,300,000.

Fig. 2 is a general map of the airport. The water area to the east of the field ranges in depth from slightly above to a maximum of approximately 3 ft. below mean low water for more than a mile from the shore line. This area will be reclaimed by filling in for the permanent airport development to give the field the desired dimensions.

Drainage—The present field is level and at an approximate elevation of 5 ft. above mean low water. Since high tides rise above this level, the field is surrounded by a levee. Rainfall is conducted into the ditch at the west side of the field and is discharged into the bay by means of a 16-in. vertical screw pump, driven by a 25-hp. electric motor, capable of discharging 5,500-g.p.m. against a 11.5-ft. head. The pump has both manual and automatic

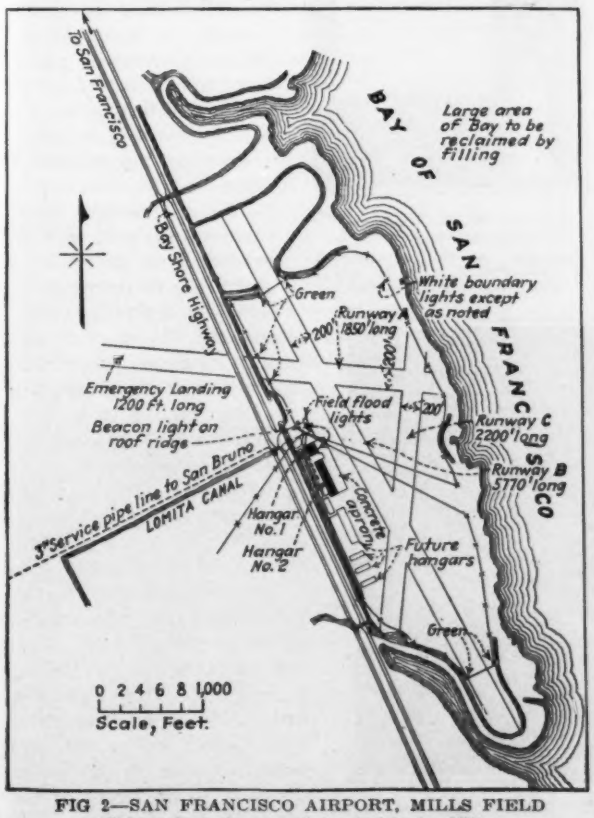


FIG 2—SAN FRANCISCO AIRPORT, MILLS FIELD
Ultimately to be extended into bay by filling.

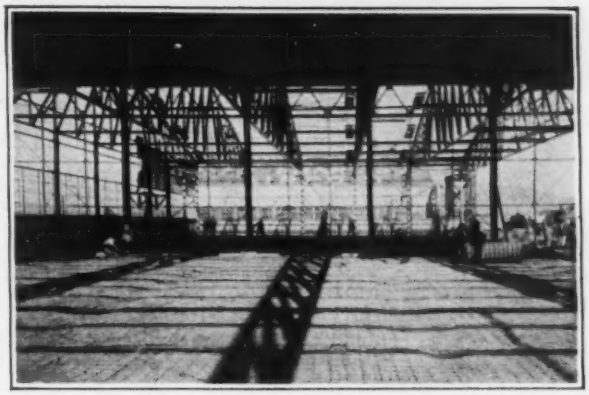


FIG. 3—HANGAR 2 PUT TOGETHER FOR EASY RAZING
The three bays are each 120 ft. wide. The reinforced-concrete floor slab extends out in front of both hangars for 100 ft.

float control. Water draining from the hills to the east is excluded from entering the field drainage canal by manually controlled gates. The natural soil surface of the field lends itself to percolation of rainfall through it into the canal except during the last portion of the rainy season. The present utilized portions of the field are provided with drains composed of perforated, galvanized, bitumen-dipped, corrugated-iron pipes laid in gravel backfilled ditches. In the permanent development it is planned to drain the whole field by means of pipe drains.

Runways—The whole area of the field is level and suitable for landing airplanes. It is covered with a turf composed of rye and bent grasses. However, it was necessary to construct runways to carry the heavier planes during wet weather. The longest runway is 5,770 ft. in length. All are 200 ft. wide. They are constructed of rolled rockfill 12 in. thick in the center, tapering toward the edges. To prevent the rocks from flying into airplane propellers, the surface was covered with 2 in. of loam, rolled and planted with grass. The airplane "Southern Cross" used these runways for endurance flight attempts during the worst of the rainy season in the winter of 1927-28 and found them satisfactory. This plane weighed approximately 16,000 lb. with the load concentrated on one axle.

Water Service—The water supply was secured through a 3-in. galvanized wrought-iron pipe 4,200 ft. long connecting to an existing main under a static pressure of 115 lb. per sq.in. The pipe size selected was based on the ordinary requirements for the use of water for domestic purposes, irrigation, etc., and to insure the use of one stream discharging 80 g.p.m. at 70-lb. pressure for fire protection. Greater fire protection for the temporary field was not considered necessary, on account of the fact that all buildings are widely separated and that the administration building and a comfort station are the only wooden structures. The fire hazard about the hangars rests primarily in the gasoline carried in the airplane fuel tanks. The pressure and discharge values adopted will allow the use of a 1-in. continuous stream of chemical fire foam from a standard generator to be used for fighting gasoline fires.

Hangars—Two hangars have been constructed. One is 105x100 ft. in plan and provides a clear entrance of 86 ft. 10 in. by 18 ft. The other hangar is 360x85 ft. in plan and is composed of three stalls, each having clear entrances of 118 ft. 10 in. by 18 ft.

The foundations are composed of wood piles about

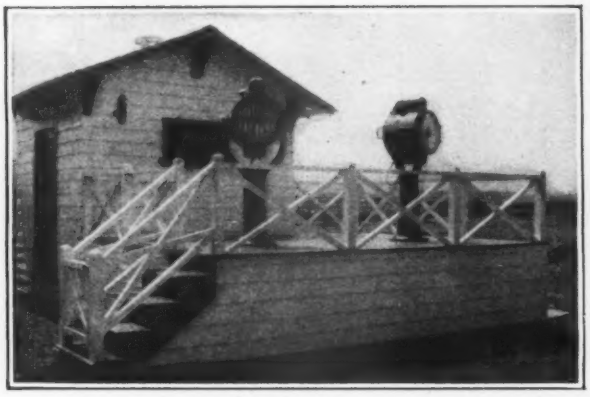


FIG. 4—SETTING FOR FIELD FLOODLIGHTS

60 ft. in length, cut off below the line of permanent saturation and capped with concrete. These separate piers are connected together by the reinforced-concrete floor system. The superstructure is of steel framing covered with corrugated metal. The steel is shop riveted and field bolted to allow for comparative ease in razing the structures and re-erecting them in their permanent locations. Each hangar compartment is equipped with an office and a washroom. In front of the hangars is a concrete apron 530x100 ft. in plan.

Administration Building—The administration building is a one-story structure of wood-frame construction having major dimensions of 33x87 ft. It houses a public waiting room with telephone booths and comfort stations, a general administration office, the meteorological station, an emergency hospital room, an air mail office, radio room, a public lunchroom and complete living quarters for five men, including a kitchen and bath.

Sewage Disposal—A separate building houses a public comfort station at one side of the automobile park. This structure rests on a reinforced-concrete floor and curb, which supports the wooden frame. The sewage is conducted to two single-compartment redwood septic tanks. The administration building connections, the comfort station and hangar 1 washroom connections drain by gravity into one tank, and hangar 2 washrooms into the second tank. The tanks discharge into the drainage ditch to the left of the field. Always, even in summer, a sufficient volume of seepage water is found in the drain ditch to carry away the effluent from the tanks. Although the discharge pipe is above the water level in the summer, no odor has been noticeable. To date the effluent has been clear. The drainage pump discharges the water from the ditch at a point approximately 1,900 ft. distant.

Transportation—The new Bay Shore highway furnishes the principal means of transportation to the airport at the present time. This highway is 125 ft. wide for its entire length and will ultimately extend from the heart of San Francisco to San Jose, 50 miles south. It borders the western edge of the field. The city of San Francisco is at present engaged in the improvement of the portion within the limits of the city and county of San Francisco at a cost of $2,250,000. The time taken to travel by highway from the post office or the business district to the hangars is not more than 30 minutes. A main line railroad is approximately 4,000 ft. west of the field. On the completion of the project water transportation to the entire eastern side of the field will be available.

FIG. 6—OUTLYING METEOROLOGICAL STATION
Stations like this established 1 mile north, 5 miles south and 8 miles south of field.

Lighting—Power is conducted to the field by overhead wires screened behind the airport buildings. At the south end of the administration building these wires terminate in a transformer bank, where the incoming 2,200-volt, three-phase, 60-cycle power is reduced to 220/110-volt power. From this point on, all wiring is underground. A small wooden structure houses meters and remote control equipment. All field lighting is handled by remote control from the administration office.

White boundary lights surround the field with the exception of green lights at the ends of the runways. Red obstruction lights surmount the top of the poles on the incoming power line.

The field is floodlighted by two 18-in. high-intensity arcs, mounted on swivels and capable of being elevated to any desired angle. These lights have removable spread lenses, each emitting a fan of light 80 deg. wide, which gives a combined fan of 160 deg. of illuminated area. By removing the spread lens, these lights may be used as ceiling projectors. They, together with their motor generator and control equipment, are mounted in a small timber structure to the north of the administration building.

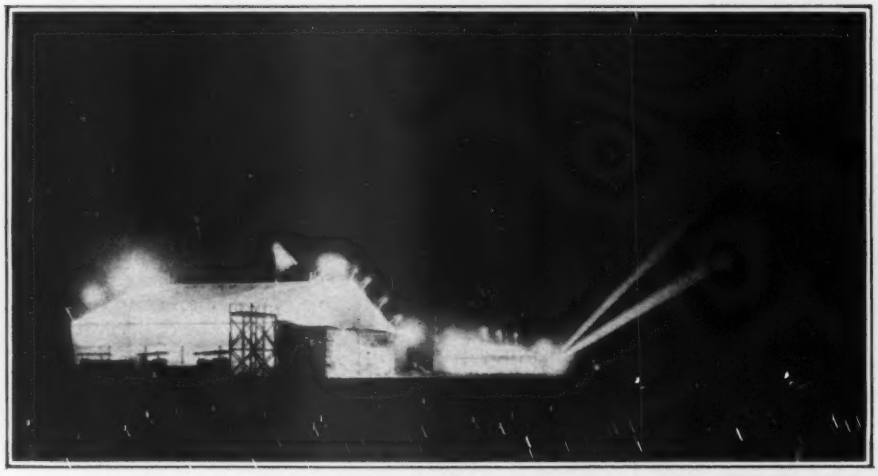


FIG. 5—EFFECTIVE FLOODLIGHTING ON HANGAR 1 AND THE ADMINISTRATION BUILDING

FIG. 7—AIRPORT BEACON AND ILLUMINATED WIND CONE ON TOP OF HANGAR

The airport beacon is mounted on a small tower on the roof of hangar 1. The wind cone is internally illuminated.

The exteriors of all buildings are floodlighted by 300-watt lamps, mounted in reflectors, supported by a conduit extending from the building roofs.

Auto Park—An automobile park in the rear of the buildings is covered with crushed rock and drained. All areas open to the public are separated from the flying field by a 6-ft. woven-wire fence. This is necessary both for the safety of the public and for the safety of the aircraft using the field.

Meteorological Equipment—Four new meteorological stations were established. The headquarters station is in the administration building and contains an anemograph, a sunshine recorder, barographs, a rain gage, thermometers, base end-stations for theodolites used in pilot balloon observations, desks, drawing tables, files and miscellaneous instruments. The three outlying stations are located at Belle Air Island, 1 mile north of the field; San Mateo Point, about 5 miles south, and Beresford, about 8 miles south. Each of these stations is equipped with an anemograph, sunshine recorder, rain gage and base end-stations for double theodolite balloon observations. A small truck is provided for the meteorologists who make a daily round of all stations to take balloon observations and change the record sheets on the automatic instruments. Four men from the office of the Weather Bureau are employed on this work, a meteorologist, an assistant and two computers. Night visibility, ceiling, etc., are recorded by the watchman.

All design and construction work was under the direction of M. M. O'Shaughnessy, city engineer. The writer was airport engineer under Mr. O'Shaughnessy for the selection and temporary improvement of the field.

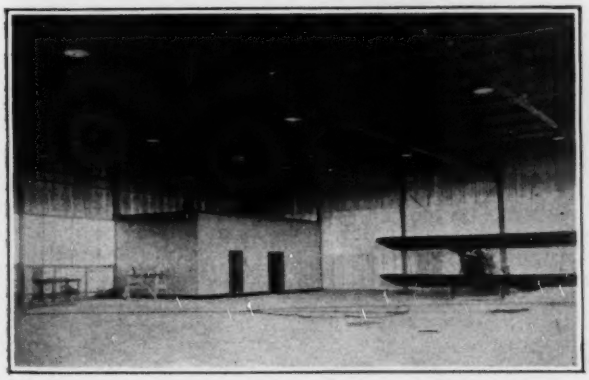


FIG. 8—INTERIOR OF 360x85-FT. HANGAR

Widening Gage on Foreign Narrow-Gage Railways

Linking Up of Individual Lines Into Connected Systems Has Led to Standard Gaging of Roads in South America and West Africa

AS A RESULT of railway extensions linking up individual lines into connected systems and the general growth of traffic, two long narrow-gage railways in South America and West Africa have been converted to the local standard gage, 3 ft. $3\frac{3}{8}$ in. in the former and 3 ft. 6 in. in the latter case.

The Antofagasta Railway, in Chile and Bolivia, has a main line of 30-in. gage extending from the port of Antofagasta to Uyuni, 380 miles, where it connects with the meter-gage Bolivian State Railway, running north to La Paz, 340 miles. In view of the increasing traffic, assisted by the recent extension of the Bolivian railways to connect with those of Argentina, it was desirable to reduce the delay, damage and expense involved in the transfer at Uyuni, and it was decided to widen the 380 miles of the Antofagasta Railway to meter gage. The first through train on the 720-mile route was operated on July 10, 1928, and the regular journey has been reduced from 42 hours to 30 hours.

The Congo Railway, in the Belgian territory of Southwest Africa, is a 250-mile line of 30-in. gage which was opened in 1898. The longer line of the Katanga Railway, in the interior of the Belgian Congo district, has the 3 ft. 6 in. gage which is standard in South Africa. The southern end of this latter road connects with the Rhodesian Railways, which in turn connect with the South African government railways, so that there is through rail communication between the Congo and the Cape of Good Hope. As the Katanga Railway is being extended north and west toward a connection with the Congo Railway, it has been decided to convert the latter to the 3 ft. 6 in. standard gage. Work is now in progress and it is expected that the whole project will be completed in 1931.

Widening Narrow-Gage Track—Preliminary work for change of gage on the Antofagasta Railway, as described briefly in the *Railway Gazette*, London, consisted in setting new screw spikes outside the 75-lb. rails. These spikes were spotted in position by a templet and partly driven, ready to fit the rails, each rail being moved outward $4\frac{11}{16}$ in. The new rail seats were trimmed where necessary and three or four new ties were placed in each 30-ft. rail length. On bridge decks, anchor bolts in the ties were countersunk where they came within the new rail seat. It was found necessary to strengthen several bridges along the route on account of the heavier engines to be operated.

In changing the gage, the old outside spikes were removed, rails shifted out against the new outside spikes, holes bored and new inside spikes driven, and the outside spikes then screwed down tight. Rail joints were uncoupled only at intervals, the rails being shifted out in long, continuous lines. For the 108-mile stretch between Ollague and Uyuni, begun on July 5, six days were allowed, with all traffic stopped. But the work was done in $4\frac{1}{2}$ days and a meter-gage pilot train was run on July 9. On this part of the line about 1,100 men were employed, in 35 gangs.

Ditching a Swamp With Dynamite for a Banana Plantation

Cerro Laguna in Honduras Drained by More Than 9 Miles of Canals Dug by Blasting at a Cost of 16c. a Cubic Yard

By W. F. Hahneman

Agricultural Geologist and Explosives Engineer, Cuyamel Fruit Company, New Orleans, La., and Puerto Cortez, Honduras

THE use of dynamite for ditching is old, but in general the width and depth of the ditches have been limited. With the prevailing methods of blasting, dynamite loses its efficacy in cleanly expelling the earth within quite narrow and shallow channel dimensions. In recent swamp drainage in Honduras the writer has developed new ditch-blasting methods which remove the limitations that until now have hampered the process. The work was done for the Cuyamel Fruit Company, which, as is the case with all the large fruit companies operating in Central America, has found it necessary gradually to extend its cultivations to meet increased demands and to offset the loss of areas which have become non-productive through soil exhaustion or other causes. This expansion has entailed the extension of railway lines until there is a long haul of fruit from plantations to ports.

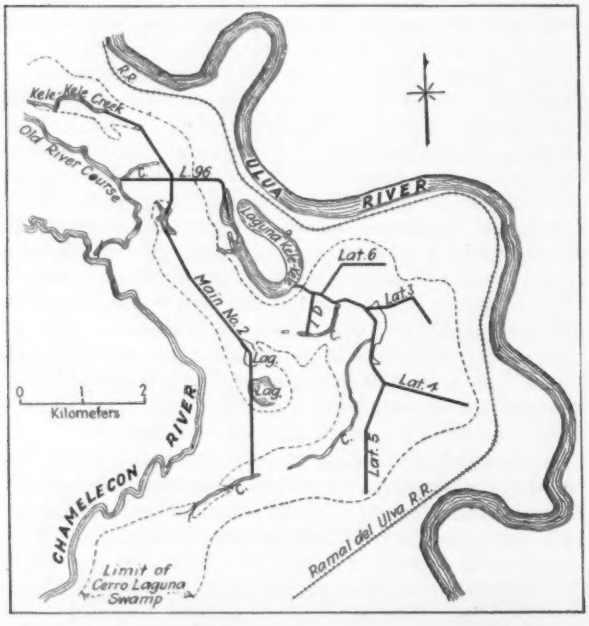


FIG. 1—CERRO LAGUNA SWAMP AND DRAINAGE DITCHES, HONDURAS

The company has realized in the past few years that economies of transportation can be secured by utilizing swamp lands along or near its railroad lines and with this in view has engaged in extensive works to reclaim such lands. Much ditching has been done by hand labor and by dragline excavators mounted on crawler tractors, but more recently it has been found that important ditches can be excavated more economically and with much greater speed by blasting.

The first large operation was to drain the swamp called Cerro Laguna (Hill Lagoon), which derived its name from a small granite hill that lies in the center of the swamp. This had from 1 to 12 ft. of standing water heavily matted with aquatic plants, grass and trees. At one time the Chamalecon and Ulua rivers, which lie on each side, had traversed the swamp (Fig. 1), leaving comparatively high ground and ridges covered with dense tropical semi-aquatic jungle and vines. At the lower

FIG. 2—BLAST 1,900 FT. LONG ON LATERAL 6

end this high ground had joined from both rivers and had blocked natural drainage. A channel was blasted through this high ground in 1926, taking off much of the surface water and allowing the soil to be examined. This was found to be suitable for the cultivation of bananas, and it was decided to drain the entire tract thoroughly.

Local conditions made machine ditching impracticable and necessitated the use of dynamite. With the idea of improving upon previous ditch-blasting methods and securing a finished, perfect canal of large size, the writer devised a system in which the depth of the canal to be made determined the quantity and location of the charges. This method when tried out in practice came up to expectations both in quality of canal made and in saving in cost and time.

The largest canal blasted was 70 ft. wide at the top, 30 ft. wide at the bottom and 16½ ft. deep. The average for all canals was around 30 ft. wide at the top and 9 ft. deep, all shot clean—no trash, grass or other material fell back into the canals. Only enough clearing was done on the ditch line to enable the men to work.

All the canals were located, profiles were taken and depths and grades were calculated before work was started. Several kilometers of canal at a time were prepared, making and springing the holes ahead of the actual blasting, which speeded up the work besides allowing the mules to rest four and five days at a time. All blasting materials were packed in on mule back, from twelve to sixteen mules being used and the longest distance packed being 8 km.

The blasting progressed at the rate of 1,600 to 3,200

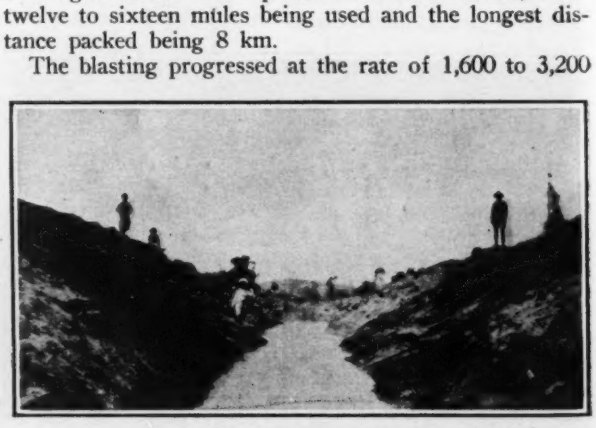


FIG. 3—DITCH 30x10x10 FT. IN SILT CLAY LOAM

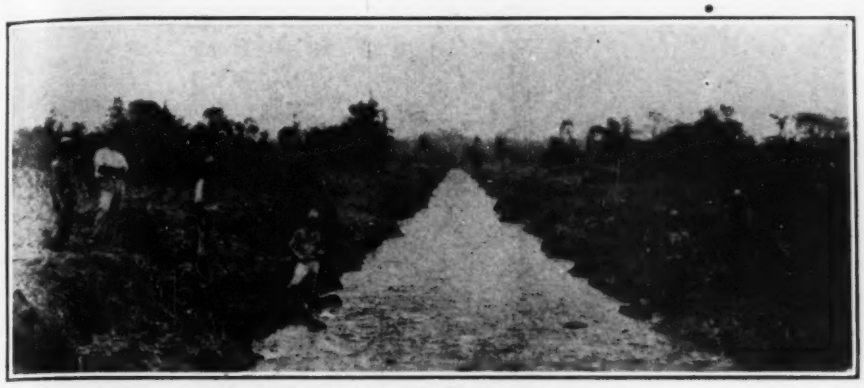


FIG. 4—DITCH 45x10x13 FT. IN DRY SAND

lin.ft. daily. Fig. 2 shows a single blast 1,900 ft. long. The longest single shot measured 2,830 ft.; 8,000 lb. of powder was used and a total of 16,000 cu.yd. of material was moved. This blast was loaded and tamped in six hours.

In no case was any trouble experienced. All kinds of soil were blasted through, sand to hard clay, wet and dry, and some with 3 ft. of standing water. Due to the comparatively heavy concentrated charges the propagated

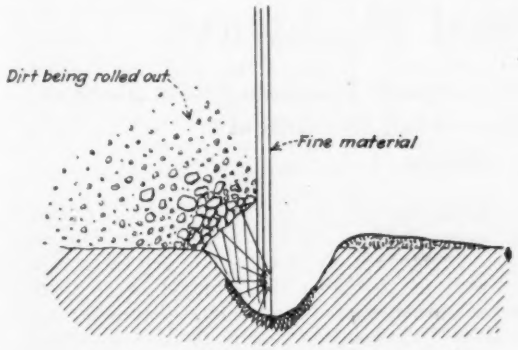


FIG. 5——DIAGRAM OF ACTION OF BLAST

system of shooting was employed, only one electric blasting cap being used for each shot. Very little stemming was resorted to in the dry and moist sandy soils. Sticks 3 ft. long slightly larger than the boreholes were rammed down and in the dry firmer soils, if water was available, enough was poured down the holes to cover the dynamite.

In firm soils the widths of the canals are approximately three times the depth; they are slightly wider at the top in looser soils. The side slopes of the canals are automatically regulated according to the natural resistance of the soil being blasted, as shown by the views, Figs. 3 and 4. The pictures were taken immediately following the blasts, and as can be seen, the blasting produced a clean-cut canal. The overhanging vegetation on the sides above 12 ft. high is not injured, due to the earth being rolled out (Fig. 5) instead of being thrown out as in previous methods.

The method in detail is as follows: A line of holes 6 ft. apart is put down in the center of the canal. Each hole is punched or bored to one-half the depth of the canal to be blasted and then is sprung and 3 lb. of 60 per cent straight nitroglycerine dynamite per foot depth of canal is loaded into each hole. The spacing of the holes does not change for canals up to 25 ft. in depth. For example, a 12 ft. deep canal would have a 6 ft. deep hole and 36 lb. of dynamite per hole. For canals from 25 ft. to 50 ft. deep the distance between holes would be 9 ft. and 4½ lb. of dynamite per foot of depth of canal would be used in each hole. For canals 50 ft. deep and deeper the distance between holes would be 12 ft. and 6 lb. of dynamite per foot of depth of canal would be used in each hole.

The only change from this schedule is in a dry sand or a dry sandy soil, when the spacing of the holes is 5 ft. up to 25 ft. depth of canal. When extra width is needed without increasing the depth, 3 lb. of dynamite for each foot of width is added to each hole.

A 2-in. primer was found sufficient for springing the holes. The cavity that this makes will take up to 50 lb. of dynamite. The tools, such as punch bars, primer inserters, loading tubes, etc., were developed especially for this method. The crew, materials and outputs on the Cerro Laguna operations were as follows:

Average number of men employed	9
Average number of mules used per day	14
Average number of electric blasting caps used for springing holes, etc., per kilometer	552
Average amount of dynamite used per day	2 tons
Average amount of dynamite used per kilometer	5.47 tons
Average amount of earth moved per day	8,000 cu.yd.
Average labor and superintendence per day	$30
Average explosive and labor cost per cu.yd.	$0.16
Average amount of material moved per pound of dynamite	.2 cu.yd

About 15 km., or 49,200 ft., of canal was blasted. Due to ocean freight, handling, etc., dynamite landed in Honduras costs around $520 a ton—about 8c. a pound more than in the United States.

Other large swamps owned by this company will be drained in the near future, due to the gratifying results obtained at Cerro Laguna. This work clearly shows the advantage of this method of blasting canals. The small crew employed, the speed with which the work can be executed, the negligible amount of capital invested in equipment and the extremely low unit cost of excavation cannot be equaled by any other method.

FIG. 6—LOADING BLAST HOLES

Fig. 1—Stretch of Hill Country Road on the Rio-Sao Paulo Highway

Trunk Line Construction on Brazilian National Highways

Federal Highways Enabling Act Passed Jan. 5, 1927—System Inaugurated With Rio-Sao Paulo and Rio-Petropolis Trunk Lines—High Standards of Roadbuilding Being Followed

BRAZIL is making notable progress in national roadbuilding. Two main trunk lines aggregating about 190 km. have been completed. These are true federal highways built by a federal government tax on gasoline and on automobiles and independently of the state road systems but connected with them to form through routes. Construction began with the passage of an enabling and financing act by the federal Congress on Jan. 5, 1927. The two roads which are completed are shown by the map, Fig. 4.

Highway Promotion—In 1916 the first Brazilian road congress was held at Rio de Janeiro under the auspices of the Automovel Club do Brazil. Then there were virtually no good roads in the country, or at most only scattered stretches of a few miles. The advent of the automobile had, however, begun to have its effect. In 1917 another road congress, at Sao Paulo, initiated the Associacao das Estradas de Rodagem. This convention fostered the good roads movement in Sao Paulo and through its connections with road organizations and

FIG. 2—MACADAM CONSTRUCTION ON RIO-SAO PAULO ROAD

FIG. 3—PLACING MACADAM SURFACING ON RIO-SAO PAULO ROAD

similar agencies in other states had a decided influence on the improvement of roads throughout Brazil. It was headed by Dr. Washington Luis, an ardent good-roads advocate. Later Dr. Luis was elected President of Sao Paulo and began actively to plan and construct a state highway system, which has grown to some 7,000 km., a third of which are good motor roads, another third roads passable all the year and another third roads passable in the dry season.

It is not the purpose to indicate further state-road development in Brazil. This much has been related, however, to make clear the antecedents of the present movement for federal roads. Dr. Washington Luis was elected President of the republic in 1926, and one of his first acts in office was to obtain from Congress a law which would give him the means for constructing federal highways. As stated, on Jan. 5, 1927, a law was passed creating a fund for federal roads to be obtained from a special tax levied on gasoline and on automobiles. At once President Luis organized the Commission for the Construction of Federal Highways and named as its head Timotheo Penteado, the engineer who had directed the work of the Department of Highways of Sao Paulo. The commission at once laid down the two trunk lines shown by Fig. 4 for immediate construction and both have now been completed.

FIG. 5—SIDEHILL ROCK CUT ON RIO-PETROPOLIS ROAD

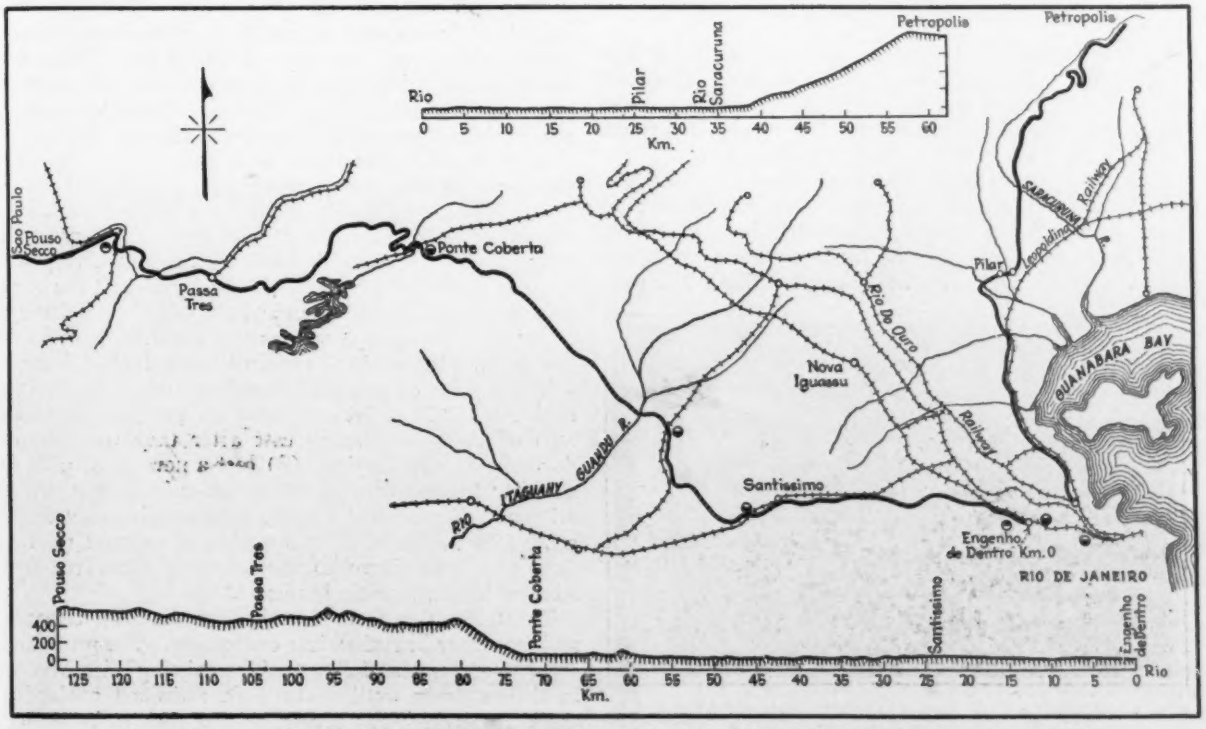


FIG. 4—MAP AND PROFILES OF TWO BRAZILIAN NATIONAL HIGHWAYS CONSTRUCTED IN 1927-28

FIG. 6—REINFORCED-CONCRETE BRIDGE ON RIO-SAO PAULO ROAD

Highway Structure—A notably high standard was established for the new national roads. The maximum grade was made 6 per cent, and the minimum radius of curve was made 50 m. (164 ft.). The minimum tangent between curves of opposite direction was made 40 m. (128.4 ft.). The roadway width was made 8 m. (26¼ ft.). The conditions except for short sections

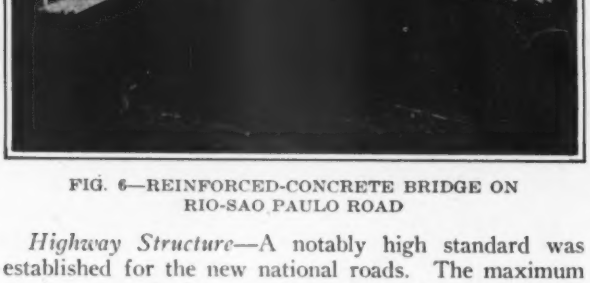


FIG. 7—REINFORCED-CONCRETE VIADUCT ON RIO-PETROPOLIS ROAD

did not demand hard pavement and the surfacing was bituminous macadam, water-bound macadam, oil-treated gravel, plain gravel and sand-clay, as the traffic and the available materials determined. All main structures, as shown by Figs. 6 and 7, were of permanent types.

As both roads traversed the lowland marshes and mangrove swamp lands and then were through a hilly zone to the Serra do Mar, some 2,500 ft. above sea level, the limitations on grade and curvature called for skillful location and often heavy construction. The profiles on Fig. 4 indicate the country traversed. A better indication of the Serra do Mar country is given by the view (Fig. 1) of a portion of the Rio-Sao Paulo road. The bridges (Figs. 6 and 7) also indicate the rugged and primeval country which is passed through.

FIG. 8—SIDEHILL CUT AND VIADUCT ON RIO-PETROPOLIS ROAD

Construction Conditions and Methods—Of the two roads the shorter to Petropolis required the heavier construction. In brief, the structures required on both lines were as follows:

	Sao Paulo	Petropolis
Length, kilometers	121	58
Excavation largely rock, cubic meters	2,921,484	1,776,872
Masonry, bridges and culverts, cubic meters	15,901	53,200
Masonry, retaining walls, cubic meters	6,715	230
Bridges, number	27	13
Culverts, number	714	502

On the Petropolis road ten of the bridges had on an aggregate length of 220 m. and three an aggregate length of 324 m. The construction operations shown by Figs. 2, 3, 5 and 8 indicate the plants and methods employed. Generally speaking, the practice of letting contracts for only small sections of road tends to reduce the use of roadbuilding machinery. Most of the work is done with pick and shovel, but planers, scrapers, tractors, rollers, levelers, scarifiers, drags and rock-excavating equipment are in use to some extent.

Concrete Piles Spliced With a Quick-Hardening Concrete

Forms Removed From Splices Two Days After Pouring—First Pile Driven When Nine Days Old—All Joints Held

By A. D. Conrow

Special Engineer, Ash Grove Lime & Portland Cement Company, Oklahoma City, Okla.

An unusual job of splicing 24 concrete piles was carried out, early this year, by the Oklahoma State Highway Department on an 80-ft., three-span, I-beam bridge constructed just east of Stillwater. The abutments of this bridge were on concrete piles and the piers were concrete pile bents. When soundings were made, a hard shale layer was struck which indicated that a solid footing would be obtainable with piles 35 ft. long. On the basis of this information the contract was let to Tom Collins, of Cushing, Okla., who proceeded late in the fall of 1927 to cast the 24 piles needed so they would be ready for use early in 1928. When piledriving was started, about Feb. 1, 1928, it was found that the shale was only a few inches thick and the piles broke through into a formation giving very poor support. It was found that 50-ft. piles would be required to reach solid footing.

Three plans of procedure presented themselves to the engineers: (1) Build up abutments and piers from the tops of the piles already cast after they were driven down to the new footing; (2) cast a new lot of piles of sufficient length to permit the bridge to be constructed as originally planned, and (3) drive the existing piles to the ground line, splice additional lengths of concrete piles on them and drive them to solid footing when the new sections had sufficiently hardened.

The third plan seemed to involve the least expense, and the writer was called into conference. The procedure agreed upon was as follows: The existing piles were to be driven down until about 4 ft. remained projecting above low water; this projection was then to be broken

down, exposing the reinforcing. To this the reinforcing for the added length of about 18 ft. was to be spliced. A perpendicular form was then to be erected over the old pile and around the reinforcing for the new section and this section molded with a quick-hardening cement concrete. The work of driving the original piles was completed about Feb. 27. The tops of the old piles were then prepared for the splice as shown by Fig. 1.

It was planned to cast the extensions in four operations —one for each abutment and pier—using only seven forms, these forms to be removed and re-erected. The reinforcing for the new section was spliced to the projecting reinforcing of the old piles as shown in Fig. 2, and the forms were erected for placing as shown in Fig. 3. The temperature at time of placing the concrete was somewhat cool, and the mixing water was heated so that the concrete came out of the mixer at between 75 and 85 deg. F. A 1:2:3 mix was used. The sand was composed largely of rounded siliceous grains. The stone was a hard, good-quality gray limestone graded 1 in. to ½ in. Each batch was mixed not less than two minutes, as the extreme fineness of the cement made this mixing time necessary to incorporate the cement thoroughly and obtain maximum early strength. The consistency of the concrete was such that it gave a slump of about 6 in.

The seven piles in the east abutment were spliced on Feb. 27. An opening was made in the form just above the top of the old pile and its surface was thoroughly cleaned and soaked with water before placing the first concrete. This first concrete was worked well into the surface of the old concrete to insure a good bond. The forms were removed on Feb. 20, about 40 hours after concreting. The concrete was hard and strong, breaking through the stone aggregate when fractured. The remainder of the piles were cast as fast as weather conditions would permit the removal of forms and their re-erection over the other piles. The forms were removed the second day after concreting.

Driving was started on March 12 on the piles in the west abutment which had been cast on March 3. The driver had a 4,000-lb. drop hammer and a steel follower cap for the pile weighing about 500 lb., in which a cushion of soft wood or rope was placed to prevent the direct impact of the hammer on the concrete.

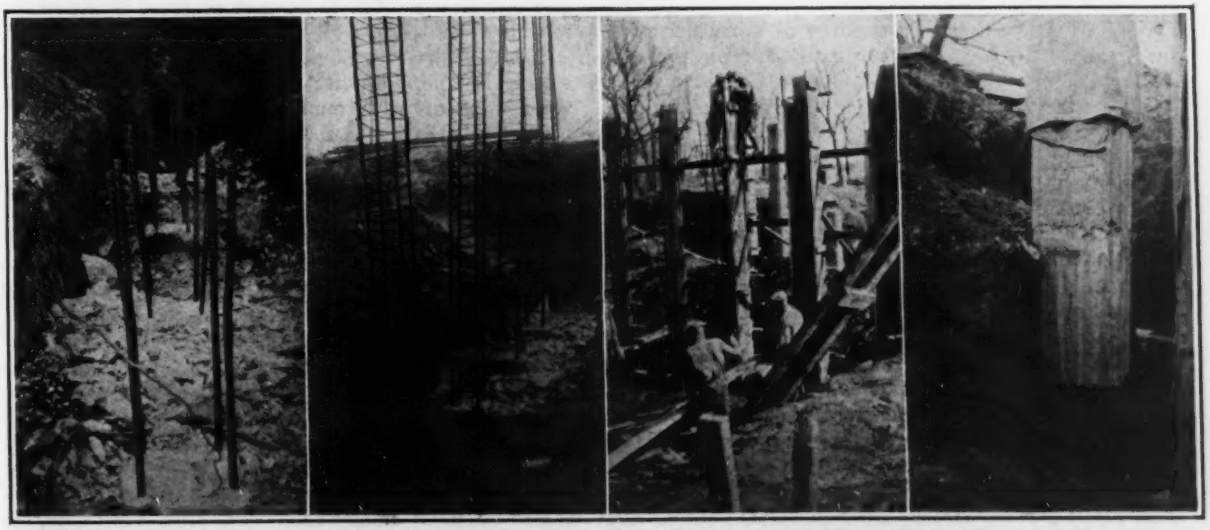
It was thought probable that jetting would be necessary to aid in sinking the piles to solid footing, but the contractor decided to attempt to drive them without the aid of water jets. Driving was started on the first pile, one in the west abutment, which had been made nine days before. About 5-ft. drops of the hammer were first used to get the cap properly set and to loosen up the pile. The height of the fall was then increased to about 8 ft., as the 5-ft. drop had little effect in forcing the pile down. The pile was found to drive very hard, as the lower or old section had been in place for about a month and sand and earth had settled around the pile.

The total pile was now heavy, it being 50 ft. in length with an estimated total weight of 13,000 lb. About two hours' driving time with 20 to 25 blows per minute was required to drive the pile about 8 ft. After about half an hour's driving, the top 9 in. had spalled somewhat, giving uneven bearing. This was cut off to a new bearing and driving was resumed, the pile going to refusal without further spalling. A test of ten 10-ft. drops of the hammer produced a penetration of ½ in., or 0.05 in. per blow, indicating a safe carrying capacity, so far as bearing was concerned, of about 38 tons.

The extremely hard driving conditions and the punishment given to the pile caused concern as to whether the spliced joint had held. An excavation down to this joint was made, and so far as could be determined, the driving had had no effect on the joint; no crack or loosening appearing that could be detected. Two other piles were driven down in this manner, but the progress was so slow and the punishment to the pile so severe that it was decided that water jets should be used to assist in driving the remainder. Excavations were made to the spliced joint on several of the piles, but no loosening of the joints could be found.

The extra cost of the pile extension due to the use of special cement was less than $175. This amount was more than saved by eliminating delay.

The construction of this bridge was under the direction of W. C. Burnham, bridge engineer of the Oklahoma State Highway Department, and was directly supervised by George Whittenburg, resident engineer during the first part of the work, and later by C. P. Smith. Mr. Burnham assisted in the preparation of this account.



SPLICING CONCRETE PILES WITH QUICK-HARDENING CONCRETE

Fig. 1—Old piles broken off to expose reinforcing bars. Fig. 2—New reinforcement attached to exposed bars. Fig. 3—Erecting forms around extended reinforcement. Fig. 4—Close view of spliced joint.

Operation of New York City High-Pressure Fire System

Three Eight-Hour Shifts at Each of Two Pumping Stations Always Ready to Provide 125-Lb. Pressure Below 34th St., Manhattan

EVERY provision against possible breakdown of service was made in the construction of the high-pressure water system used for fire protection in the lower portion of the Borough of Manhattan, New York City. The system was first placed in operation in 1908. Today it contains practically the same plant and equipment as was originally installed and is operating as perfectly as it did twenty years ago. The method of operation is described in this article.

As originally constructed, the system provided fire protection for the area south of 23rd St., from Third Ave. westward to the Hudson River. This area at the time embraced what was known as the drygoods district. Forty of the fire department pumping engines were to be replaced by this system. Later on, the district was enlarged by two additions to include nearly all of Manhattan borough south of 34th St., which is now served through 128 miles of 12- to 24-in. cast-iron pipe and 2,746 fire hydrants. Two electrically operated stations, each containing six centrifugal pumping units of from 3,000 to 5,000 g.p.m. capacity working under a pressure of 100 to 300 lb. per sq.in., were constructed. The two stations are identical in construction and layout, one being located in the easterly and the other in the westerly portion of the district. Each station is near the river and contains a suction chamber from which duplicate suction lines lead to a screened intake chamber at the river. Although these salt water intakes were included in the original installation, they have never yet been used. The valves of these lines are kept in good condition by periodic operation, and the suction lines are occasionally flushed out with fresh water. An electric-driven air pump exhausting from a steel drum attached to the suction lines raises the salt water to a point above the level of the pump, thus eliminating the necessity for priming.

Croton Water Normally Used

Aside from the unlimited quantity of salt water available by means of the connections to the river, water is available from both the Catskill and the Croton supplies. Under normal operation the Croton supply is used and is delivered to the pump by gravity at a pressure of about 40 lb. per sq.in. The pressure on the Catskill supply varies from 50 to 60 lb. per sq.in. at the pump. A bypass connection around the pump, which is metered, supplies the high-pressure system at all times with water from the Croton system. When the pumps are started up, on an alarm, a check valve on this bypass closes and the pressure on the system is built up to 125 lb. per sq.in.

The electric current supply comes from the New York Edison Company through four direct feeder lines, any one being capable of operating all of the equipment in the pumping station. The current is supplied over the feeders at 11,000 volts and is stepped down to 6,600 volts in transformers located at the pumping stations. All motors operate at this voltage with the exception of small direct-current motors used to operate valves and other control mechanisms.

Each pumping station has a telephone switchboard directly connected with fire department headquarters and a telephone operator constantly on duty. The fire alarm boxes in the high-pressure district are shown in large figures on a board mounted on the wall next to the telephone operator.

An arbitrary line subdivides the high-pressure area into two districts. The pumps are started in one station only when alarms are turned in within that district. When an alarm comes in which requires the operation of the high-pressure system, the telephone operator signals the watch engineer by means of a ship's telegraph. One of the pumping units is immediately started, and when the pressure reaches 125 lb. per sq.in. it is held there by means of an automatic pressure regulator connected to the pump discharge. This pressure regulator is controlled from a small handwheel located in front of each starting panel on the switchboard. Pressure gages on the switchboard show the operator the discharge pressure. Should a second alarm occur while a station is in operation, the practice is not to start the other station, but to carry whatever additional consumption is required from the one station.

The area on the East Side is covered by a duplex system. Mains on alternate streets are connected in one system, while those on remaining streets are connected to another system. Should a break occur while under high pressure, it is possible to close down the system with the break and continue using the other system. In actual practice hydrants on both systems are used at fires and a break in either system would simply mean that the hydrants on the broken system would be dead.

System Controlled by Telephone

Supplementary to the fire alarm system, there are 300 telephone stations scattered throughout the high-pressure district, directly connected with the pumping station over leased wires of the New York Telephone Company. A member of the fire department is on duty within calling range of one of these telephone stations during a fire and notifies the pumping station when the fire is out. These telephones are also used in notifying the pumping stations when changes in pressure are required, the officials of the fire department having complete control over the amount of pressure maintained during fires. The records show that water is used on a fire in only about one out of every ten times that pressure is put on the system.

Each of the two discharge lines from the pumping station is equipped with venturi meters, which record the amount of water pumped. Even when no water is used at a fire, there is some water pumped into the system, due to leakage, although the department has been unable to locate the leaks by systematic leak survey and believes that the individual leaks are very small.

There are four engineers on duty at each plant, together with four oilers, three telephone men and four laborers. An extra telephone man permits each of the operators to have one day off in a week. The other employees are on duty in eight-hour periods every day of the week. A special maintenance gang is assigned to the high-pressure distribution system. This gang consists of a machinist and a helper, five calkers and about twenty laborers, the actual number depending upon the amount of work being done.

W. W. Brush is chief engineer of the Department of Water Supply, Gas and Electricity, New York City. P. Quilty is borough engineer of water supply for the Borough of Manhattan.

From Job and Office

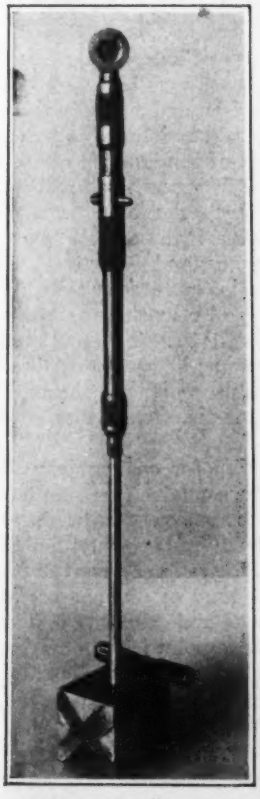
Hints That Cut Cost and Time for the Contractor and Engineer

Micrometer Target for Lining Up Machinery With Instrument

A MICROMETER target rod for use with an engineer's level instrument in setting heavy machinery, designed to give the rod a degree of accuracy comparable to that made possible by the instrument, was used in lining up hydraulic turbine shafts in the Buck's Creek hydro-electric plant in California. The device consists of four parts: (1) a micrometer caliper of standard make whose length is extended by (2) an Invar metal measuring rod, (3) a cross-hair attachment which constitutes the target proper and (4) a weighted block to hold the device upright on its base.

A target containing cross-hairs is set on top of the micrometer gage, to the lower end of which is attached the measuring rod. Thus the rod can be put down inside the confined space within the bearing housing to get a direct reading on either shaft or bearing, as may be desired. Having the micrometer at the top makes it possible to raise or lower the target conveniently while it is being observed through the level telescope. With this device it is possible to bring the shaft to the correct elevation and also to make it exactly level at the same time.

The rod is held upright by a weighted V-block in which there is a hole parallel to one of the outer faces of the block. The hole is reamed so that the rod makes a snug fit therein but extends entirely through the block to make direct contact with the shaft. A small level is used to place the rod in the vertical plane passing through the longitudinal axis of the shaft and thus when finally adjusted the lower end of the micrometer rod will be in contact with the highest point on the shaft. For use in bearings of different diameter it is, of course, necessary to change the extension rods which are provided in different lengths.



MICROMETER TARGET ROD FOR PRECISE LEVELING

The target proper consists of a small metal disk with a ½-in. hole in the center. Into this hole is fitted a piece of clear celluloid $\frac{1}{16}$ in. thick, upon which are scribed two fine lines, 90 deg. apart and crossing in the exact center of the hole. To make these lines extremely fine they were first scribed on the celluloid and afterward the surface was rubbed down so that the width of the line was gradually reduced until the desired fineness was obtained.

The metal disk that supports this celluloid center has a radial hole into which the upper end of the micrometer snugly fits, this end extending into the target proper until it is just tangent to the ½-in. hole. This adjustment was secured by filling a flat face on the outer edge of the target, removing just enough metal to bring the end of the micrometer to the tangent point. The intersection of the cross-lines is thus placed at a distance of exactly ¼ in. from the head of the micrometer. This amount is added to each micrometer reading.

In using this device, it is desirable, in the interest of accuracy, to have the level instrument set up at a point equidistant from the two bearings to be leveled. This tends to correct slight irregularities in the adjustment of the level instrument itself. It is also desirable to take readings from positions first on one side of the shaft and then on the other. By averaging the readings taken over a number of observations from both positions, it is said to be possible to set a shaft so that the difference in elevation of two bearings a considerable distance apart will be not more than a few thousandths of an inch.

While this device was developed by engineers of the Pelton Water Wheel Company, of San Francisco, for leveling the main shaft of an impulse turbine, it is believed to have wide application in erection of machinery where accurate leveling of various parts is essential.

Toledo Orders 600 Street Signs of New Design

THE city of Toledo recently placed an order for 600 street name signs to be installed in the downtown section of the city and at intersections in other parts of the city where traffic lights are located. The specifications for the signs were based upon a series of experiments carried on in Boston by Adolph J. Post, senior assistant engineer of the public works department, and George H. McCaffrey, then secretary of the Good Government Association of Boston and now acting director of research for the Merchants Association of New York. The tests are completely described in a pamphlet written by these men and published by the Municipal Administration Service, 261 Broadway, New York City. The type of sign is shown in the accompanying illustration. A summary of the conclusions reached during the study gives the following characteristics to the ideal sign: (1) Height and width of key letter *M* to be 4 in., width of stroke to be 0.8 in.; (2) figures for house numbers to be 2 in. high; (3) dullest possible background, sanded black smalt; (4) brightest possible reflecting letter, either a non-tarnishing gold leaf or a prismatic glass; (5) material to

TYPE OF STREET SIGN ADOPTED IN TOLEDO
Figures denote house numbers in blocks on either side.

be used, wood; (6) to be placed projecting over roadway, semaphore fashion with 14½ ft. clearance.

The specifications drawn from the experiments for this ideal sign are as follows: (1) Signboard: 10 in. wide by 1 in. thick, of A No. 1 sugar pine; (2) two priming coats of white lead, sandpapered between coats, all knots shellacked and all cracks puttied; (3) sizing applied roughly to the shape of the letters; (4) gold leaf applied to the sized surface; (5) letters accurately cut in with lampblack ground in oil; (6) while still wet sprinkle thoroughly with black smalt and shake off excess; (7) allow to dry, away from dust, for two days at a temperature of 60 to 80 deg. F. The gold leaf should be larger than the visible letter; by thus extending beneath the black paint, a lap joint is formed and all moisture is excluded.

Standard Bill of Material Form for Draftsmen Saves Time

By Morton Schwam
Philadelphia, Pa.

MUCH time can often be saved in the drafting room by using the standard form as illustrated in the accompanying drawing in laying out the bill of material instead of laying out the spaces required directly on each

Part No.	Name	Stock Size	Quantity Required	Assembly

To suit width of drawings

BLUE-LINE PRINT FORM FOR BILL OF MATERIAL

tracing. The standard form is made up on a tracing from which a vandyke and in turn blue-line white prints can be made. The blue-line prints can be distributed to each draftsman and slipped under the tracing as a guide whenever a bill of material is required.

Derrick Mast Moved on Motor Trucks Over Winding Road

IN MAKING an extension to power house No. 8 on the Big Creek hydro-electric project of the Southern California Edison Company, it became necessary to transfer a wooden derrick mast over about 3 miles of mountain road. Despite the fact that some of the curves on this road have a radius of only 30 ft. and grades up to 15 per cent were involved, the move was made successfully by two motor trucks, one of which supported either end of the timber.

85-FT. DERRICK MAST MOVING TO NEW LOCATION

The mast was a dry pine stick, 85 ft. long, 2 ft. in diameter at the center and 18 in. in diameter at the ends. With the metal attachments as moved, its total weight was about 1,500 lb. In loading the mast on the trucks, cribs of 12x12-in. timber were built up to raise the point of support on each truck above the top of the cab. In each crib the topmost timber was hewn out at the center to make a cradle that would prevent the timber from rolling off, and cleats were spiked to the mast to prevent it from slipping endwise in the cradle.

On the front truck the cradle was lashed in place with a moderate amount of play. On the rear truck the cradle was also lashed but still more loosely, and in this case a kingpin was used to transmit thrust from the cradle timber to the layer of cribbing next below at the same time that free turning was permitted.

From Job and Office

Hints That Cut Cost and Time

Hydraulic Chart for Determining Flow in Conduits and Channels

By Charles E. Sharp, Jr.
Assistant Engineer, Missouri Pacific Railroad, St. Louis, Mo.

USE of the chart given herewith makes it possible to solve complex problems involving the flow of water through open and closed conductors without the usual cut-and-try balancing of sets of independent calculations. Two or more problems may easily be focused upon the chart for direct comparison and adjustment as, for example, in designing several sections of a sewer with various slopes and amounts of minimum flow.

Superimposed upon the main chart are two auxiliary diagrams for determining, for any section, the "equivalent rectangle" which has the same hydraulic characteristics. It has been found that sewers and water conduits of commonly used shapes may be quite accurately resolved into an equivalent rectangle by considering invert and sidewall heights and the arch rise. The first step in solving a problem is to determine, by means of these auxiliary charts, the height of this equivalent rectangle in terms of the total width, D, of the section that is to be used.

The chart on the left gives this for commonly used closed conduits. It is entered horizontally from the left at a value, h, equal to the ratio of total vertical height to total width of the stream. Follow this horizontal line to its intersection with the value a, the ratio of invert depth to D. Then parallel the curving lines of the diagram to an intersection with c, the ratio of arch rise to D. The value on the left scale opposite this point is the effective depth of the equivalent rectangle. In constructing this diagram the area of the waterway and the hydraulic radius has been computed for an actual water depth of $hD - 0.05D$ for all sections except those in which c is equal to zero. This value gives approximately the maximum flow.

On the right a similar chart gives the same result for

From Job and Office

For Contractor and Engineer

open channels with sloping sides. Note that, in this case, the width D is the average width of the stream.

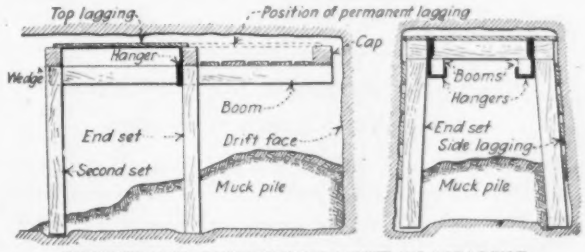
Of the three values n (roughness coefficient), s (slope) and Q (flow in sec.-ft.) two will be known, the third to be determined. To determine Q, for instance, enter the main chart at the intersection of the s and n lines for the values given. Follow parallel to the dotted line of the diagram to intersect the abscissa for D, then parallel to the nearest parabolic curve to the ordinate marking the effective h, already determined. Drop vertically to read Q from the logarithmic scale at the bottom.

To avoid confusion in the intermediate factor v (velocity) has been omitted from the diagram. An approximate value, usually all that is required, can easily be obtained by the relation $v = Q \div A$. This chart gives results within a maximum error of 5 per cent, which is well within reasonable design in practice. It is based upon the formula $Q = AC\sqrt{RS}$ and Kutter's formula.

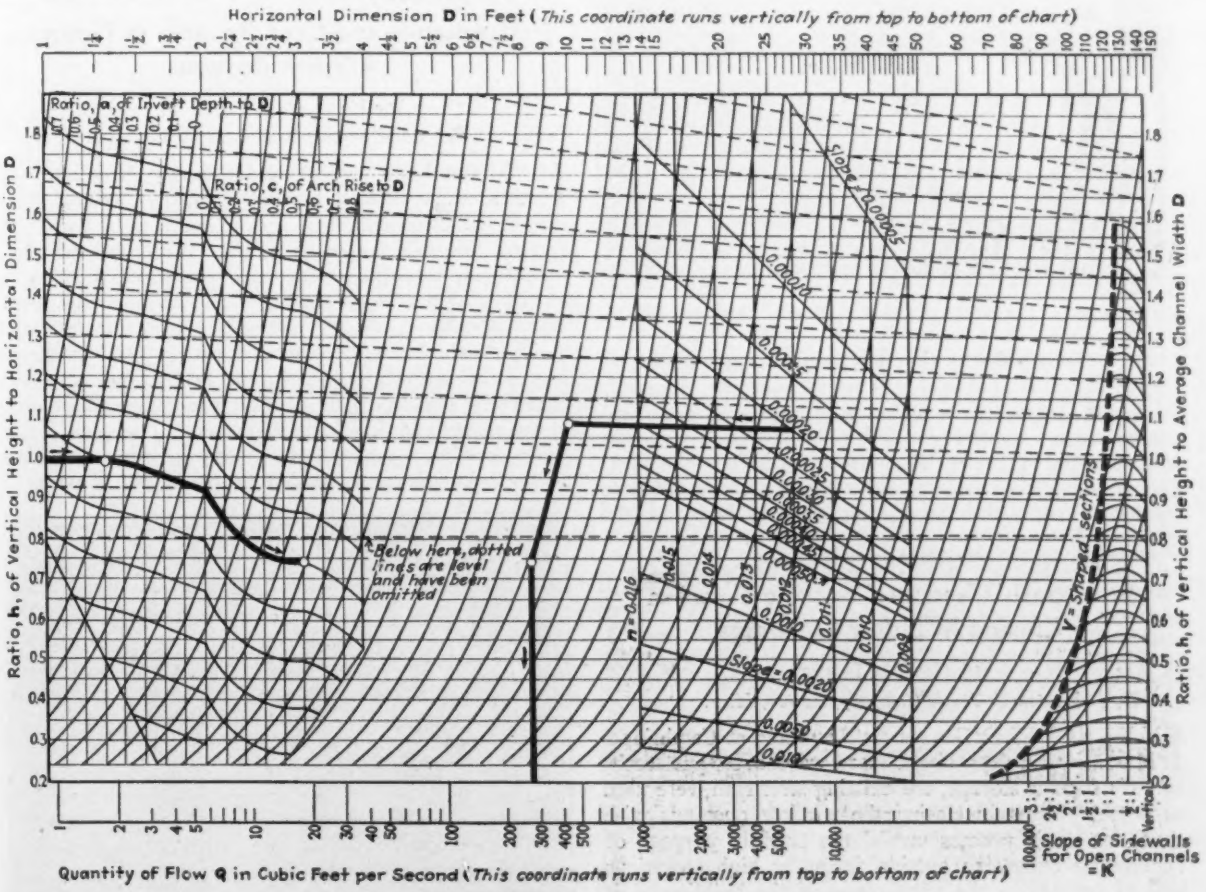
The solution of a practical problem is shown on the chart. Assuming a 10-ft. circular conduit, $n = 0.012$, $s = 0.0002$, it is required to determine Q. For a circle, the total height $h = 1.0D$, and the ratios a and c both equal $0.5D$. Enter the left edge of the diagram at 1.0 and follow through horizontally as shown by the heavy line to intersect the value $a = 0.5$, thence parallel to the curved lines to intersect $c = 0.5$. The depth of the equivalent rectangle is read from the left scale as 0.75. Now enter the main portion of the diagram at the intersection of $n = 0.012$ and $s = 0.0002$, move horizontally to the left to meet the vertical line $D = 10$ ft., thence parallel to the parabolic lines downward to $h = 0.75$. On the scale below read $Q = 275$ sec.-ft. Checking by formula, $Q = 273$ sec.-ft.

Roof Protection for Muckers in Tunnel Headings

A METHOD of protecting muckers in mine drifts which may be applicable also in tunnel headings is shown by the accompanying drawing. As described by G. Townsend Harley, mining engineer, Las Cruces, N. M., in the *Explosives Engineer*, after a round has been shot and before the mucker goes in, stirrups or hangers are hooked over the cap of the last timber set



TEMPORARY CANTILEVER ROOF IN HEADING


Horizontal Dimension D in Feet (This coordinate runs vertically from top to bottom of chart)
Ratio, a, of Invert Depth to D
Ratio, c, of Arch Rise to D
Below here, dotted lines are level and have been omitted
Slope = 0.0005
Slope = 0.0020
n = 0.016
n = 0.015
n = 0.014
n = 0.013
n = 0.012
n = 0.011
n = 0.010
n = 0.009
V-shaped sections
Ratio, h, of Vertical Height to Horizontal Dimension D
Ratio, h, of Vertical Height to Average Channel Width D
Quantity of Flow Q in Cubic Feet per Second (This coordinate runs vertically from top to bottom of chart)
Slope of Sidewalls for Open Channels = K

FLOW CHART FOR OPEN AND CLOSED CONDUITS
Based on Kutter's formula and the formula $Q = AC\sqrt{RS}$

and booms are slid through them toward the face, their rear ends resting under the cap of the second set. Hangers are made of strap iron, ½x1½ in. or ½x2 in. Booms are 6x8-in. or 8x8-in. timbers, and where the tunnel sets are spaced 5 ft. c. to c. the booms would be about 11 ft. long.

As the mucking advances lagging is placed across the booms. As soon as a 5-ft. length has been mucked beyond the last timber set, a regular cap is laid across the booms, in position for the next set. To place the posts for the new set, a wedge is driven between the second cap and the rear end of each boom, thus raising the front end of the boom and the supported cap enough to stand the posts under it. The wedges are then knocked out and cap is lowered onto the posts. When the set is blocked in position, the lagging is removed from the booms and put in place over the caps.

Stockpiles Arranged for Convenience and Yard Space Economy

IN THE construction of a large steam-electric generating station at Long Beach, Calif., it was desirable to stock the concrete aggregate in a small space whence deliveries could be made conveniently to the concrete mixing

CONVENIENT AGGREGATE STORAGE NEAR MIXING PLANT

plant. Placing the stock piles between spur tracks, as shown in the accompanying illustration, made it possible to unload from gondola cars with either one or two locomotive cranes as might be desired. Dry batches for the mixer, including cement from the storehouse in the background, are delivered by gravity to a car in the A-frame tunnel, whence the car is hauled by cable to the mixer skip.

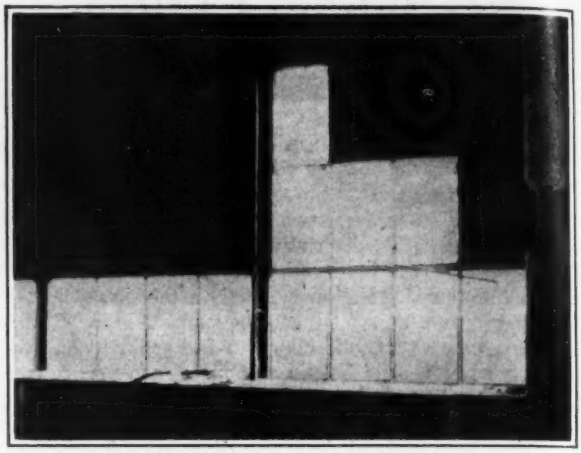
Steel Sash Used as Concrete Form in Closing Window Openings

By G. W. Maker

Morton C. Tuttle Company, Boston, Mass.

IN REMODELING a concrete building at Cambridge, Mass., into a department store warehouse, part to be suitable for fur storage, the existing steel sash were used as outside forms in closing the window openings with concrete. This process served the twofold purpose of eliminating expensive outside forms at high elevations and of preserving the appearance of the building as it was before remodeling.

The glass was broken out and the openings were



STEEL PLATES REPLACING GLASS IN STEEL SASH USED AS CONCRETE FORMS IN CLOSING WINDOW OPENINGS

cleaned by means of an air-driven chisel. Thin steel plates were then set in the openings, held in place temporarily by wooden sticks until the usual glazing clips were put in. An inside form was then erected and the sash tied to it at several points to prevent spreading. Concrete was placed through a narrow opening along the top of the form.

The Morton C. Tuttle Company of Boston was contractor on the work.

Performance and Cost Records in Guniting a Tank Bottom

By F. W. MacLennan

General Manager, Miami Copper Company

IN BUILDING recently a dewatering tank the engineers of the Miami Copper Company, Miami, Ariz., sought the combination of a thin and a tight bottom by making the dished slab of gunite. Tightness was held particularly essential as the tank was to be built on the top of a high tailings sand pile and any leakage would make possible a slip or subsidence of saturated sand. As the tank was to be equipped with a Dorr thickener, it was constructed with a sloping bottom and was comparatively shallow, 6 ft. deep at the edges, 29 ft. deep at the center and 325 ft. in diameter.

The bottom was made 2⅛ in. thick with a reinforcement of 4x4-in. mesh welded fabric of No. 7 wire. A

GUNITING TANK BOTTOM, MIAMI COPPER COMPANY

1:3½ gunite was employed. Guniting was begun at the center and proceeded in concentric rings working outward. This procedure allowed water to be admitted at the center and to cover the bottom closely following its placing. No part was left unsubmerged after the second day and during this uncovered period the slab was kept well sprinkled. The illustration shows the guniting process; the water is shown covering the part of the bottom which is completed.

Altogether the area covered was 86,854 sq.ft. The number of gun shifts (eight-hour) worked was 22¾; therefore the area covered per shift averaged 3,818 sq.ft. The actual expenditures were:

	Amount	
Labor:		
Gunite crew	$696.54	
Carpenters	504.56	
Laborers	2,115.62	
Miscellaneous	346.23	
Total labor		$3,662.95
Materials and Supplies:		
Cement	$4,028.60	
Reinforcing	3,223.43	
Pipe and fittings	862.71	
Miscellaneous	1,200.02	
Total materials and supplies		9,314.76
Grand total		$12,977.71

From these figures the cost per square foot was 14.942c. and the cost per cubic yard (573 cu.yd.) was $22.65. It should be noted that these costs include nothing for power, plant charges, overhead or profit.

Letters to the Editor

Discussion by Readers of Bridge Approach Slabs and Veneered Concrete

Bridge Approach Slabs; Experience in New Jersey

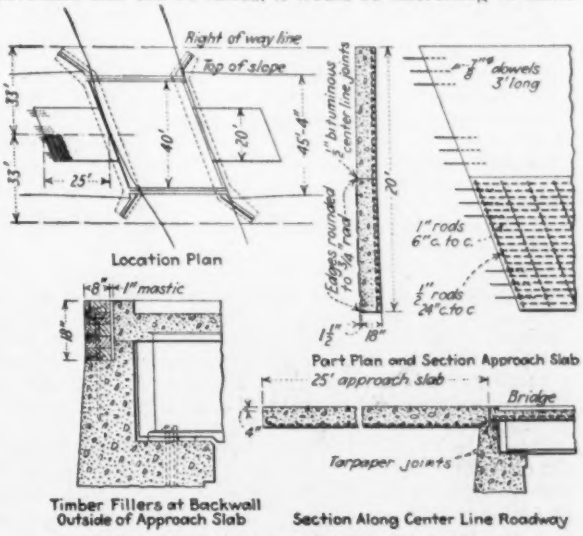
Sir—It was with much satisfaction that I noted in your issue of Sept. 6 the article by W. H. Rabe on "Reinforced Approach Slabs for Highway Bridges," for this apparently unimportant detail in the design of a bridge has given the writer many a restless hour trying to devise a foolproof approach.

Approach slabs similar to those described in the article mentioned have been in general use on bridges of the New Jersey highway department since the beginning of 1923, at which time standard plans were prepared, in which the length and design of the approach slab were made a function of the height of the abutment. Our practice at that time was practically the same as that described by Mr. Rabe; but experience with several hundred bridges constructed since then has caused us to make a number of changes which we consider improvements, and we are even now ready to admit that we have not solved this problem.

The construction of a new bridge, even when on old alignment, may very often necessitate a rise in grade either because of increased floor depth required or increased underclearance, or both. This will result in a certain amount of embankment on the approaches, the settlement of which will depend on the character of the material, its depth and the manner in which it is placed and compacted. However carefully the work of embankment is performed, full settlement can come only with time, and the installation of approach slabs as described in the article, while curing an evil immediately back of the abutment, may introduce another and possibly a more objectionable fault at the end of the slab.

A settlement of ¾ in. in a fill of 3 to 4 ft. might quite readily result after a road has been opened to traffic, even though everything practicable was done to compact it originally. Applying this settlement to a slab 8 ft. in length, such as is permitted by Ohio as a minimum, will result in a most uncomfortable jolt to one riding at 45 to 50 m.p.h. The effect of striking this sudden change in grade, slight though it may be in itself, may be sufficient to throw a passenger against the roof of a car.

I cannot agree with the statement, "If the approach embankment is considered firm enough to justify the immediate construction of the highway pavement, it is firm enough to support the approach slab." Rigid pavements have been built and will continue to be built on embankments that slowly and surely continue to settle under traffic without the slightest disadvantage to the pavement or to vehicular traffic. This settlement is practically uniform and will eventually cease. The abutment end of the approach slab is absolutely fixed in elevation and to apply the same criterion to the approach slab as to the highway pavement may result in very unsatisfactory construction. The statement that "the embankment end [of the approach slab] can later be raised if necessary" is not quite clear. If it is intended to mean that both the approach slab and adjoining pavement slab can be raised, it would be interesting to learn



APPROACH SLAB AS APPLIED TO INCASED I-BEAM BRIDGE

The slab has the standard 25-ft. length, and is not flared but has the same width as the road pavement, 20 ft.; the bridge is 40 ft. wide between curbs

whether the author has ever tried this and whether he considers it practical or feasible.

In our opinion the length of slab should depend not only on the depth of the abutment but also on the amount of embankment required on the approaches. In New Jersey, on new alignment or on grade separations requiring unusual depths of embankment, temporary pavement is laid on the approaches until such time as the fill has attained its final settlement. Seats are provided on the abutments for future concrete approach slabs, and the space occupied by these seats is temporarily filled with white oak timbers bolted to the abutment. These serve to protect the concrete headers or pavement of the bridge. When approach slabs are laid on embankment of ordinary depth they are made 25 ft. long, so that any settlement that might reasonably be expected will not seriously affect the riding qualities of so long a slab.

We have abandoned the use of the flaring width of approach slab and now make it constant to agree with that of the road pavement. This is to facilitate the future widening of the roadway pavement to meet the width of the bridge.

The use of the 25-ft. slabs has eliminated to a considerable degree the difficulties which we experienced from slabs designed for a length bearing a certain ratio to the depth of abutment; but we still encounter instances when, due to the character of the embankment material or the urgency for opening a road before the fill has had an opportunity to be fully compacted, sufficient settlement occurs after traffic has used the road for some time to be readily noticeable. At the present time our pavements are practically all concrete and the approach slabs are brought up to grade.

To reduce further the objectionable features of settlement, we intend to apply a bituminous wearing surface both to the approach slab and to the adjoining roadway slab, so that it may be built up as required if settlement should occur.

Typical details of our approach slabs as well as a timber protection on the back-wall beyond the limits of the slabs are shown by the attached drawing. MORRIS GOODKIND,

Trenton, N. J., Sept. 19, 1928. Bridge Engineer, State Highway Commission.

The Question of Veneered Concrete

Sir—Having read with great interest the articles on the Boyds Corners dam in the issues of Aug. 2 and 16, I cannot repress a slight doubt after reading the instructive articles of Aug. 23, concerning the Caneadea dam, which is being built according to the same method, although for other reasons and with unique care and precaution.

The concrete body and its facing with ashlar or brick are of course made at the same time and will stick together firmly at their surfaces of contact. In the course of time the concrete will shrink and the masonry will remain behind. A shearing stress must then arise between the pair of different compounds, causing the masonry coating to split off and bulge outward, as at the Boyds Corners dam. But that strain and splitting off cannot take place without injuring the concrete body, which, being prevented from shrinking, will develop cracks; and some of them, penetrating throughout, will allow water to percolate as shown likewise by the old dam mentioned above.

Veneering on the water side, owing to its wetness, may be expected to be of less influence than veneering on the opposite side. The sealing, as observed on some concrete surfaces, is due to shrinking rather than to frost, aside from the fact that the behavior of concretes is very different according to the cements used. Therefore I doubt whether such veneerings might be regarded as an improvement and a protection of concrete walls.

It must be borne in mind that there is a difference between the qualities to be required of masonry dams and any other masonry structures. The failure of a reservoir dam may, according to evidence, happen to be far more disastrous than that of any other kind of human work. The principal requisite must be safety, without regard to saving of time or money. Therefore most intensive study and professional knowledge and skill must prevail in designing and erecting such structures.

It remains to be seen what may possibly be expected from the so-called expansion joints, so often mentioned recently. Is it really established that the action of changes in external temperatures might penetrate sensibly beyond the surface into a high body of dense stony material and cause it to crack? As I have recently shown in the *Ingenieur Zeitschrift*, that effect has never been stated in regard to the largest engineering structures of the kind, when built in real, compact masonry. The St. Francis dam is a most instructive example.

How are such expansion joints imagined to act? The bottom of the wall rests on the surface of the rock and cannot be expected to move gently to and fro upon that rugged surface into which it is in a way indented, lest the bottom surfaces be sheared asunder and their material be ground to powder, which, meeting with water, would be changed into slippery mud. But the cracks arising from top to bottom in big concrete walls have nothing to do with temperatures. They result from shrinking and are a fatal and yet inevitable property of concrete, especially of chuted concrete. Such cracks are impossible in sound rubble masonry made according to the fundamental prescriptions of Graeff and Rankine. (See *Annales* des Ponts et Chaussees, 1866, p. 181, and *The Engineer*, 1872, p. 1.)

It is obvious that shrinkage taking place throughout and in every direction may split a wall to pieces and may even, by an action as mentioned above, damage the foundation.

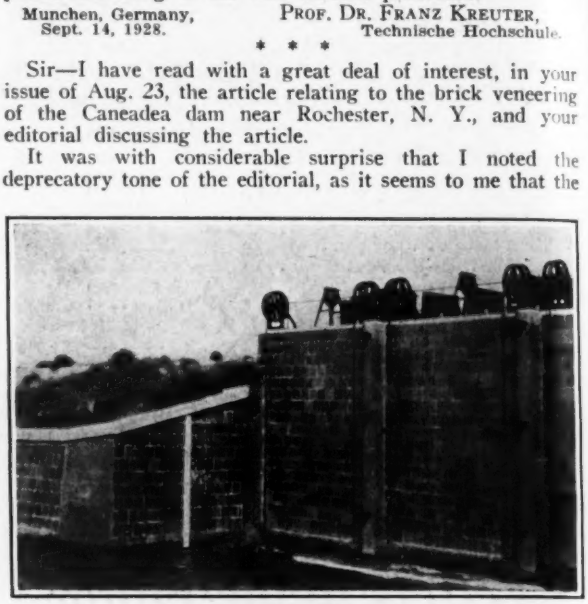
Concerning the contraction joints in the Caneadea dam, I suppose that when the lake is being filled the set of sections, lacking stability, will together incline toward the axis of the cylindric structure, so that those joints will be compressed at their tops and possibly gaps will arise at the abutments, which, after being filled artificially, will render the whole arrangement illusory. That inclination of the sections must, moreover, create a fissure at the backward toe, exposed to the pressure of the highest water column. The vaulted structure, however, will probably withstand any danger, so much the more as the concrete employed is composed and placed according to the best modern procedure.

Munchen, Germany, Sept. 14, 1928. PROF. DR. FRANZ KREUTER, Technische Hochschule.

* * *

Sir—I have read with a great deal of interest, in your issue of Aug. 23, the article relating to the brick veneering of the Caneadea dam near Rochester, N. Y., and your editorial discussing the article.

It was with considerable surprise that I noted the deprecatory tone of the editorial, as it seems to me that the



SPLIT HOLLOW BUILDING TILE USED AS VENEERING FOR IRRIGATION HEADGATE

officials in charge of the project have been engaged in a sincere and honest attempt to solve the very real problem of making concrete permanent. It is becoming more and more certain that integral treatment or surface coating will not suffice under all conditions and that we must turn to some such device as veneering.

In Canada, veneering with split vitrified hollow building tile is being tried, as indicated in the accompanying photograph of an irrigation headgate in Alberta. The tile are 12 in. square and about 1½ in. thick over all. They are salt glazed. The intermediate webs form an anchor to the concrete. Columns and rounded corners were treated with a mineral waterproofing material, because special tile forms were not available. R. A. HART,

Salt Lake City, Utah, Sept. 20, 1928. Consulting Engineer.

* * *

Sir—The issue of Sept. 13 shows that your editorial of Aug. 23 entitled "The Question of Veneered Concrete" has attracted sufficient interest to prompt some response, so another letter (from me) should not disturb you much.

Perhaps I can best express my reaction in the form of a question, the answer to which I have been seeking for some time. Here it is.

When the merits of concrete are being discussed, why do we usually predicate our discussion on the assumption that its quality is, as you express it, "good concrete," but when the merits of brickwork are under consideration, it is usually assumed that its quality is probably of the poorest?

To put it another way, when the demerits of concrete are mentioned, the ready response is that if it had been of the proper quality, such demerit could not exist. But when brickwork is anything but the *poorest* quality, such an instance is the exception.

I have yet to be convinced that *good* brickwork is not just as prevalent as *good* concrete in masonry construction all over the country.

And we have never dared to alibi the shortcomings of brickwork by the plea that if it had been "good" brickwork such defects would not have existed. L. B. LENT,

Cleveland, Ohio, Sept. 21, 1928. Engineer Common Brick Manufacturers Association of America.

News of the Week

Bids to Be Opened Soon for Wanaque Aqueduct

Bids for the Wanaque aqueduct will be opened Dec. 6, according to an announcement by the North Jersey District Water Supply Commission. The work will involve approximately 164,000 ft. of 72-in. steel pipe line with appurtenances. Plans and specifications will be available at the office of the commission, 24 Commerce St., Newark, N. J., about Nov. 22. Fuller & McClintock are the engineers.

Alteration of Queensboro Bridge to Increase Capacity

Construction of a new vehicle roadway on the upper deck of the Queensboro bridge, New York City, has been approved by the Board of Estimate. The new roadway will increase the number of traffic lanes from six to nine and the capacity of the bridge, which is now about 65,000 cars per day, by about 50 per cent. At the same time new approaches to the structure will be opened at both the Manhattan and the Long Island City terminals to take care of the additional traffic. The cost of the entire improvement is placed at about $6,000,000.

St. Francis Flood Débris Causes Further Flood Menace

Débris left in the channel of the Santa Clara River after the flood caused by the failure of the St. Francis dam last March is now being studied with a view to correcting the resulting menace. It is feared that raising of the streambed and other changes of the thread of the channel, due to the presence of this débris, may so change the effect of annual floods as to endanger lands not heretofore flooded or menaced with erosion. Practically the entire channel of the Santa Clara River from the mouth of San Francisquito Canyon to the sea, a total of about 50 miles, is involved. Much of the valley along the channel is in orchard or other highly developed land.

The question of the extent to which Los Angeles should co-operate in this work and assume part of the cost is under investigation. Survey crews of the Los Angeles Water Department have made detailed surveys along the river. C. T. Leeds and A. L. Sonderegger are working with H. A. Van Norman, assistant chief engineer, Los Angeles Water Department, in reviewing the situation for the city of Los Angeles in co-operation with Charles W. Petit, Ventura County engineer, assisted by A. C. Hardison.

Pennsylvania R.R. to Electrify N. Y.-Philadelphia Line

Gap Between Present Electrified Sections to Be Closed at Cost of $100,000,000

THE board of directors of the Pennsylvania Railroad has authorized the electrification of the train service, both freight and passenger, of its entire lines between New York and Wilmington, Del., including also electrification of the grades between the Susquehanna, Schuylkill and Delaware River valleys. A total of 325 miles of line and 1,300 miles of track is included in the authorization, beginning at Hell Gate bridge, New York, and extending west and south to Wilmington, Del., and west from Philadelphia on the main line as far as Atglen, Pa. The total cost of the undertaking is estimated at $100,000,000, and the work will extend over a period of seven or eight years.

Single-phase alternating current will be used similar to that now in operation on the company's Philadelphia suburban service and also used on the New York, New Haven & Hartford, the Norfolk & Western, and Virginian railways in this country, and extensively in Europe. Multiple unit cars will be used on the suburban service, while through freight and passenger trains will be handled by electric locomotives.

Future plans indicate that when the present project has been carried out and the electrified section of the main line is extended as far west as Harrisburg, Pa., electrification will be undertaken in the Pittsburgh region and that this latter will gradually be connected with the eastern lines as conditions warrant.

Plans for the electrification were announced by W. W. Atterbury, president, who stated that no issue of securities was contemplated at the present time, as the cost, at the rate of about $15,000,000 a year, can probably be met from the current income of the company.

Building Temporary Roadway on Harahan Bridge

Construction of a temporary roadway on the north side of the Harahan bridge at Memphis, Tenn., has been started, and it is expected that the bridge will be opened to highway traffic by about Nov. 15. The temporary roadway will probably have ample capacity to take care of vehicular traffic, superseding the free ferries which have been operated since Sept. 17, when fire destroyed the timber decking of two spans of the bridge, as reported in *Engineering News-Record*, Sept. 27, 1928, p. 489.

RECLAIMING THE ZUIDER ZEE FOR DUTCH FARMERS

K. L. M., Royal Dutch Airlines Photo

This photograph shows construction work in progress on an 18½-mile earth embankment which will separate the Zuider Zee, a tidal lake in Holland, from the waters of the ocean. It is part of a tremendous project of the Netherlands government which will cut off a total of 915,000 acres, 550,000 for farm land and the remainder for use as a storage reservoir to hold the drainage water pumped from the farms, and also the discharge from several small rivers. The outlet to this lake will consist of 25 concrete sluice gates, one of which is seen in the foreground, discharging into the ocean at low tide. The cost of the entire project will be more than $200,000,000. Work on a large scale was started in 1925, and it is expected that cultivation of a part of the reclaimed area will begin in 1934, although the entire project will not be completed until 1940.

Brief News

CONSTRUCTION OF A 6-MILE RAILROAD by the Southern Pacific Company has been approved by the Interstate Commerce Commission. The new line will be in the vicinity of Fresno, Calif., and is designed to relieve congestion in the yards at that point. Estimated cost of construction is $252,379, and the work is to be completed before Dec. 31, 1929.

A DREDGE OF UNPRECEDENTED SIZE for use on inland rivers is being constructed for service on the lower Mississippi. The hull will be 150 ft. long, 70 ft. wide and 13.6 ft. deep, and will carry a trussed timber boom 232 ft. long, which will handle a 15-cu.yd. clamshell bucket.

A DISTRICT OFFICE of the U. S. Geological Survey, Water Resources Branch, has been opened at Fort Smith, Ark. W. S. Frame is district engineer in charge. The new office has been established to compile information on the water resources of Arkansas and adjoining states.

A POTABLE WATER SURVEY of Bergen County, New Jersey, is to be made by the North Jersey District Water Supply Commission for the Bergen County Water Commission, of which Douglas Thomson, Mayor of Englewood, N. J., is chairman. Particular attention will be given to the Ramapo River as a possible source of supply for Bergen County communities and also for the city of Bayonne, in Hudson County. To meet the cost of the survey, $8,000 has been appropriated by the Bergen County Board of Freeholders. Arthur H. Pratt, Newark, N. J., is chief engineer of the North Jersey District Water Supply Commission.

A COURT DECREE against the discharge of fuel oil waste into the Schuylkill River above the Philadelphia waterworks intake has been issued by the Montgomery County Court in a suit brought by the city of Philadelphia against the Cooper's Creek Chemical Company, whose plant is located near Conshohocken. After three witnesses had been put on the stand, the case was halted, the opposing lawyers conferred and the company agreed to stop polluting the creek.

THE USE OF AN AIRPLANE for observing highway conditions has been inaugurated by the State Highway Department of Colorado.

A NEW SUSPENSION BRIDGE is practically completed at Necochea, Argentina, a pleasure resort about 300 miles from Buenos Aires. The structure consists of a main span of 500 ft. and two 200-ft. approach spans. A stiffening truss of the rigid continuous type is suspended from the cables. The cost of the structure is given as $700,000.

CONTRACT LET FOR TALL BUILDING

The general contract for the 68-story Chrysler Building to be built on Lexington Ave., between 42nd and 43rd Sts., New York City, has been awarded to Fred T. Ley & Company, Inc., Springfield, Mass. The total height of the structure will be 808 ft., 16 ft. more than the Woolworth Building. The estimated cost is $14,000,000. A brief description of the structure, formerly known as the Reynolds Building, was given in *Engineering News-Record*, Aug. 2, 1928, p. 181. Demolition of old buildings on the site is already in progress, and completion is expected early in 1930.

Golden Gate Bridge Assessment District Approved by Court

A decision overruling protests of property owners to the formation of an assessment district to finance the Golden Gate bridge was announced Nov. 3 by Judge C. J. Luttrell, of the California Superior Court. This decision comes as the result of a series of hearings held in the six counties which it is proposed to include in the district. A review of the situation appeared in *Engineering News-Record*, Dec. 1, 1927, p. 890.

A complete copy of the decision is not available as this issue goes to press, but dispatches indicate that it disposes of the objection that properties to be taxed would not be benefited. The next step in the project will be the appointment by the supervisors of each county of the directors who will represent the several districts. They, in turn, are to arrange for an election at which bonds for financing the bridge will be voted upon. The six counties within the proposed district are: San Francisco, Marin, Sonoma, Del Norte and parts of Napa and Mendocino. San Francisco will have six directors, Sonoma two, and the others one each. Lake and Humboldt counties, which it was originally proposed to include, have withdrawn from the proposed district.

In this decision the court did not pass on the constitutional questions raised at the hearings, ruling that this court was without authority to decide such issues. These points are to be fought out in the appellate court.

Reject Many Clip Angles for Potomac Bridge

A consignment of clip angles intended for reconstruction incident to the resurfacing of the highway bridge crossing the Potomac River at Washington, D.C., was recently rejected by the District Bridge Department after several had failed during construction because of segregation of the metal. The first failure occurred when a field bolt was being tightened. Seven other angles similarly broke during erection. Therefore all of the batch not already riveted into place were rejected. Those in place were reinforced against future impact stresses by shelf angles underneath.

Chemical analysis of samples in the original inspection showed satisfactory material. The crystalline inclusions found in the cracked pieces showed high sulphur and phosphorus content. The jobber had furnished the consignment out of stock which had come from several mills. Since trouble was found with only eight out of 26,000 pieces, the defect might well have been in a shipment from one mill or even in one single length of angle iron from which the clips were cut. However, since it was impossible to distinguish defective pieces at sight, it was deemed necessary to reject the entire lot.

Changes in Standards Body Unanimously Approved

Unanimous approval by the 37 member bodies of the establishment of the American Standards Association to succeed the American Engineering Standards Committee is announced by William J. Serrill, assistant general manager of the United Gas Improvement Company of Philadelphia. Mr. Serrill was chairman of the Standards Committee and now becomes president of the American Standards Association. One of the most important results of the abandonment of the committee form of organization will, according to Mr. Serrill, be a much greater degree of participation by trade associations in the direction of the national industrial standardization movement.

One of the first acts of the association will be the organization of a board of directors composed of twelve industrial executives. This newly created board, which was established in recognition of the increasing part which executives are playing in the standardization movement, will control the general administration and policies of the association. The old main committee, made up of

representatives of all the member bodies, now becomes the standards council, and in its hands will rest all matters connected with the adoption and approval of national standards.

The officers of the association are, in addition to Mr. Serrill: vice-president, Cloyd Chapman; secretary, P. G. Agnew; and assistant secretary, F. J. Schlink. The advisory committee of industrial executives includes: J. A. Farrell, president of the U. S. Steel Corporation, chairman; George B. Cortelyou, president of the Consolidated Gas Company; John W. Lieb, senior vice-president of the New York Edison Company; L. F. Loree, president of the Delaware & Hudson Company; and Gerard Swope, president of the General Electric Company.

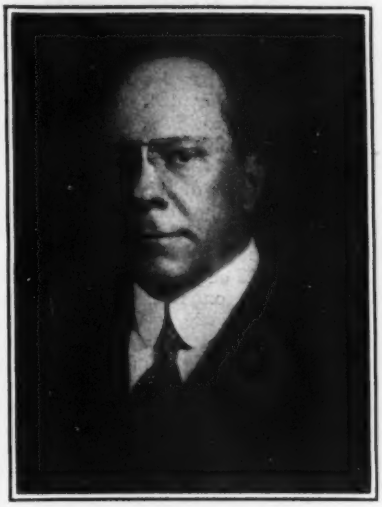
The American Engineering Standards Committee was organized in 1917 by the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Society for Testing Materials. The purpose of the organization was to provide a method of cooperation which would prevent duplication in standardization work and the promulgation of conflicting standards. The United States government departments of War, Navy and Commerce became members of the committee in 1919. New members were from time to time added until at the time of the present reorganization there were 37 member bodies. There are in addition 350 sustaining members, including manufacturers, distributors, associations, etc.

Reconstruction of High Bridge Aqueduct Completed

The official ceremonies marking the completion of the alterations made on the High Bridge aqueduct, New York City, were held on Oct. 27. In addition to the ceremonies on the bridge, a marine pageant was held on the Harlem River, signalizing the opening of the river to traffic between the Hudson and the East rivers. The reconstruction work on this historic Roman type masonry aqueduct was described in *Engineering News-Record*, Dec. 1, 1927, p. 864. It involved the removal of four masonry arches and their replacement by a single steel arch span. The work was undertaken at the instance of the War Department to provide a clear ship channel in the Harlem River. The new arch has a span of 425 ft. and a navigation clearance height at the center of 100 ft. above mean high water. During the reconstruction the aqueduct pipes, consisting of two 36-in. diameter cast-iron pipes and one 90½-in. diameter wrought-iron pipe, were removed. The wrought-iron pipe was replaced on the new structure and is now in use. The repair work was carried out by the P. T. Cox Contracting Company, New York City, under the supervision of the Department of Plant and Structures, E. A. Byrne, chief engineer.

Richard L. Humphrey Dies

Richard Lewis Humphrey, consulting engineer and active leader in many technical societies, died Nov. 2, in Philadelphia. Mr. Humphrey was born at Marblehead, Mass., in 1869, and was graduated from the University of Pennsylvania as a civil engineer in 1891. After a short period of railway work, he was employed by the Department of Public Works of Philadelphia to design sewers and bridges. While there he established and developed the Philadelphia Municipal Testing Laboratory, in which are tested all materials used by the various departments of the city. In 1899 Mr. Humphrey became general manager and engineer for the Buckhorn Portland Cement Company, having entire charge of the design, erection and operation of the company's 1,200-bbl. cement mill. He entered consulting work in 1903, specializing in the inspection of material and the examination of cement properties. Besides acting as adviser to a number of cement companies, Mr. Humphrey was engineer in charge of structural material testing laboratories at St. Louis, Pittsburgh and Atlantic City for the U. S. Bureau of Mines.



Richard L. Humphrey

Mr. Humphrey always took a leading part in the activities of technical societies with which he was affiliated. He was one of the organizers and first secretary of the American Society for Testing Materials, the first president of the American Concrete Institute and a director of the American Society of Civil Engineers. In 1924 he was awarded the Wason medal of the American Concrete Institute for two papers, "Twenty Years of Concrete" and "The Promise of Future Development." He was also chairman of the Pennsylvania board for registry of professional engineers and a member of the Engineers Club of Philadelphia.

During the war Mr. Humphrey served as director of the Building Materials Division of the Council of National Defense.

Western State Engineers Form Association

The first annual meeting of the Association of Western State Engineers was held in Salt Lake City, Utah, Oct. 29-31. The association, the main purpose of which is to formulate principles and exchange ideas on the subject of the use, control and regulation of water in the seventeen Western states lying wholly or partly in the semi-arid West, is non-political in nature, but the constitution states as one of its purposes the preservation to the states of their inherent right to use, control and distribute the water of their streams. Reno, Nev., was selected as the meeting place for 1929. George W. Malone, state engineer of Nevada, was elected president and George M. Bacon, state engineer of Utah, secretary. The executive committee consists of the president, R. K. Tiffany of Washington, and George A. Norris of Texas.

A number of papers were read on various phases of water use and regulation. Great interest was shown in all of these, and lively discussions were held on the questions brought up. Among the papers presented were: "The Relation of the Federal Government to States Relative to the Control of Water," by Sardis Summerfield, Reno, read by W. W. Ray; "Duty of Water, With Special Reference to Control by Adjudication," by M. C. Hinderlider, state engineer, Colorado; "Proposed State Laws Covering Dam Construction," by R. K. Tiffany, state engineer, Washington; "Proper State Control and Protection of Individual Appropriators of Underground Water," by Harold Conkling, California; and "Ownership of Return Flow in Its Relation to the Relative Rights of a Stream System," by R. I. Meeker, Colorado.

Committee Advises Cast-Iron Pipe Be Used at Dallas

Use of cast-iron pipe instead of steel pipe with electrically welded longitudinal joints for 30- and 36-in. force and trunk distribution mains in improvements to the water-works of Dallas, Tex., has been recommended by the Ulrickson advisory committee on expenditure of a bond issue for various purposes voted some months ago. The recommendation agrees with that of F. G. Cunningham, of Fuller & McClintock, consulting engineers, New York City, noted on p. 563 of *Engineering News-Record* of Oct. 11, 1928. If the advice is followed, the contract for supplying this and smaller pipe, totaling some 20 miles, will go to the U. S. Cast Iron Pipe & Foundry Company for $995,376, and for laying the pipe, with leadite joints, to the Robuck-Humphries Company, Omaha, Neb., for $215,629, a total of $1,211,006, the lowest combination of the various bids opened Aug. 10.

In the item on this subject published Oct. 11 the subheading erroneously stated that the consulting and local engineers differed as to this award.

Use of Chicago Wheel Tax for Street Repairs Demanded

Only 63.7 per cent of the wheel tax money collected in Chicago from vehicle owners goes into the only lawful use—street repair. In 1908, 99 per cent was so used. The Chicago Association of Commerce has made an exhaustive investigation of the beneficiaries of this fund and has suggested to the administration an apportionment that will put 93 per cent into actual repair work, a condition that has not existed since 1910.

This apportionment is as follows: Collection, not to exceed 2 per cent; administration, to include a condition survey, superintendence and maintenance of equipment (but not purchase of new equipment), not to exceed 5 per cent; for repair of major streets, 40 per cent; for repair of local traffic streets, 35 per cent and the balance, 13 per cent, to be expended in the repair of heavily traveled streets not sufficiently provided for by the assignment above, which is distributed to the 50 wards on the basis of four factors: miles of paved streets, 40 per cent; vehicle registration, 30 per cent; area, 15 per cent, and population, 15 per cent.

This year the collection will be $4,500,000. By a suggested method of checking delinquents by co-operation with the state licensing bureau it is believed the collection can be increased by considerably more than $50,000.

Iowa Sewage Treatment Conference

Fifteen topics relating to sewage treatment will be discussed at the tenth annual Iowa Conference on Sewage Treatment to be held Nov. 20-22 at Iowa State College, Ames, Ia. Lectures, demonstrations and round-table discussion of every-day problems make up the three-day three-session program, which is to be informal and largely non-technical.

Plan Inspection Trip of European Ports

A tour of seven weeks to be spent in visiting the outstanding ports of England, Germany, Belgium and France is being planned by a committee composed of R. S. MacElwee, Charleston, S. C.; S. A. Thompson, secretary of the National Rivers and Harbors Congress; Major Daniel I. Sultan, resident member, Board of Engineers for Rivers and Harbors; J. Spencer Smith, New York City; C. H. Newman, secretary, Society of Terminal Engineers; George F. Nicholson, harbor engineer, Los Angeles, Calif.; and Major L. R. Lohr, editor of the *Military Engineer*. It is planned to leave New York on April 20, 1929, and to visit Liverpool, Manchester, Hull, London, Rotterdam, Amsterdam, Bremen, Hamburg, Lübeck, Kiel, Berlin, Stettin, Düsseldorf, Duisburg, Cologne, Paris and Havre.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Survey of U. S. Streams Makes Progress—New M. R. C. Officer—"Foreign" Contractor Question

PROGRESS has been such on the power, flood-control and irrigation surveys of the nation's streams authorized under the flood-control act of 1928 that the office of the Chief of Engineers expects that half of the reports will be completed by the first of the year. Charts have been set up recording the status of the project on the rivers in each of the 42 engineering districts.

The report on flood conditions at Pittsburgh for which Congress made separate provision is expected to be in the hands of the Chief of Engineers by the middle of November. It is understood that, among other things, this report will recommend the diversion of water from the upper Allegheny into Lake Erie during high-water stages at Pittsburgh. Such diversion, it is claimed, will be of advantage in raising the levels of Lakes Erie and Ontario and also will make possible more power development at Niagara. It is estimated that 100,000 kw. of primary power will be made available at Dunkirk, where the water will be discharged into Lake Erie.

Mississippi Reservoirs

Further surveys in the Mississippi basin between Baton Rouge and Cape Girardeau are unnecessary to determine that reservoirs in that area are not economically feasible. A statement to that effect was made by Maj.-Gen. Edgar Jadwin in reply to a protest by Senator Ransdell, of Louisiana, who wrote General Jadwin that he is "greatly disappointed at the failure of your board to provide for careful surveys to ascertain whether or not reservoir sites are available before deciding definitely upon the Boeuf River floodway."

In reply General Jadwin said: "When you consider the great number of surveys that the Mississippi River Commission has been making for 48 years and the many drainage surveys that have been made, you will realize that the data in this section of the valley are ample to establish the facts necessary for the flood-control project and that the board acted wisely in its exercise of the discretion given to it by the law. The study of turning the St. Francis basin into a series of reservoirs showed that such a scheme is not economically feasible, even if the people of the valley were willing to give up the lands for such a purpose."

In his letter of protest, Senator Ransdell says the floodway should not be more than 5 miles wide. "I am absolutely opposed to the plan of a fuse-plug spillway under any circumstances," he says. "If it is finally decided to locate a floodway in the Boeuf River section, the land within the protection levees should be cleared of timber, highway and railroad embankments for a width of 2 miles, in order to give the water free flow."

To this General Jadwin rejoins: "It would be unwise to undertake to make a narrow floodway in the Boeuf basin. The quantity of water that may leave the main river in a superflood is too great to be carried in a restricted width."

In regard to the use of land in the floodways, General Jadwin says: "To remove from agricultural use all the lands required by the Mississippi River in extreme floods would not be economically sound. The people in the Mississippi Valley will want to develop these lands and work out the best method of partial use of the lands required by the river at great intervals, just as people in other parts of the world have worked out similar problems. It is not likely that the railroad embankments will cause any material amount of impounding, since the waters that always have gone through those basins have brought about the necessary openings."

Appointed Secretary of M. R. C.

In carrying out a change of policy whereby added responsibility is to be placed on the shoulders of the secretary of the Mississippi River Commission, Major Paul S. Reinecke, assistant chief engineer of the Federal Power Commission, has been assigned to that post. Heretofore the duties of secretary have been performed by officers with the rank of captain. General Jackson, president of the commission, is understood to have requested the assistance of an officer who could be a real second in command, thereby allowing the president of the commission to devote himself exclusively to major problems. In addition to the U. S. Military Academy, Major Reinecke has attended the Carnegie Institute of Technology and the Army Engineers' School. He has seen service previously on the Mississippi at New Orleans, Memphis and Rock Island. Before taking over the position as assistant chief engineer of the Federal Power Commission 3½ years ago Major Reinecke was district engineer at Buffalo.

A. G. C. Considers the "Foreign" Contractor

As the result of a tentative survey of the situation concerning "foreign" contractor competition in the building industry, the Associated General Contractors has decided that prompt action is necessary to curb the alleged abuses of this unrestricted competition. D. H. Garber, the association's general manager, expressed himself as firmly convinced that the last thing contractors want is regulatory legislation to restrict construction operations to local concerns. He believes that the cure must be worked out by the industry itself.

It is felt that the best method of acquainting local contractors with the seriousness of the situation would be the determination of more facts as to the amount and type of "foreign" bidding. The Associated General Contractors be-

lieves that not the least troublesome phase of such bidding is the labor situation. Such practices, they point out, as that of an out-of-state contractor bringing non-union men into a closed shop town in another state cause trouble.

Some contractors have claimed that out-of-state bidders on road work start in with a 3 per cent edge on the local concerns that undergo expense in connection with advertising the project. The Associated General Contractors believes, however, that since commercial construction constitutes the major part of building operations, this section of the industry should receive the first attention.

Engineering Societies

CALENDAR

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Springfield, Ill.; annual meeting, Chicago, Ill., Nov. 12-15.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York, N. Y.; annual convention, Biloxi-Gulfport, Miss., Nov. 13-17.

AMERICAN ROAD BUILDERS' ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; annual meeting, New York, N. Y., Jan. 16-18.

THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION at its annual convention, Nov. 13 to 17, at Biloxi-Gulfport, Miss., will hear the following papers: "Steel and Its Markets," by C. H. MacDonald, Colorado Fuel & Iron Company; "Structural Steel in the Federal Building Programs," by J. Edward Cassidy, consulting engineer, Washington, D. C.; "Welding as Applied to Structural Steel," by Fred T. Llewellyn, president, American Welding Society; "Flame Cutting of Structural Steel," by E. A. Doyle, consulting engineer, Union Carbide & Carbon Corporation; "The Buyer's Attitude on Competitive Selling," by L. F. Boffey, editor, *The Purchasing Agent;* "Character in Salesmanship," by C. K. Woodbridge, president, Kelvinator Corporation; "Fire Protection," by Clinton T. Bissell, associate consulting engineer, National Board of Fire Underwriters; "Steel Joists in Buildings," by Frank Burton, consulting engineer, Detroit; and "Art in Bridge Design," by Dr. J. Horace McFarland, chairman, Pennsylvania State Art Commission.

THE GREAT LAKES HARBOR ASSOCIATION will hold its annual meeting at Toledo, Ohio, on Nov. 15 and 16. The program includes an address on "Port and City Planning" by R. S. MacElwee and papers on harbor improvements and harbor administration. Raymond H. Weins, Milwaukee, Wis., is secretary.

THE NEW ENGLAND WATER WORKS ASSOCIATION will meet at 1 p.m. on Nov. 14 at the Boston City Club. Karl R. Kennison, designing engineer, Metropolitan District Water Supply Commission, will present a paper, with illustrations, on "Decolorization by Storage in Clean Bottom Reservoirs" and Raymond C. Allen, of Manchester, Mass., will talk on "The Gas Producer Plant for Water Pumping at Manchester, Mass.; A Record of Twenty Years."

THE ENGINEERING CLUB OF MONTREAL on Oct. 26 gave a complimentary dinner to Henry Holgate on the occasion of his retirement from the presidency of the club after thirteen years of service.

THE BOSTON SOCIETY OF CIVIL ENGINEERS, at its Nov. 14 meeting, will hear Samuel L. Ware speak on the new Atlantic City convention hall.

Personal Notes

GANO DUNN, president of the J. G. White Engineering Corporation and until recently chairman of the National Research Council, has been elected as an alumni trustee of Columbia University.

GEORGE M. DEXTER, for the last twelve years executive engineer in appraisal and report work with the Eastern division of the Honolulu Iron Works Company, New York City, is now with Peabody, Smith & Company, Inc., investment bankers, New York City. His duties are those of an engineer examining properties for proposed financing and developing meritorious new financing. Previously to his service with the Honolulu company he was with Hazen & Whipple, New York City, the Oregon Short Line Railroad and the U. S. Engineers in Wheeling, W. Va.

C. R. ST. CLAIR, recently assistant engineer, Pennsylvania Railroad, has resigned to take the position of chief engineer of the Kelly-Atkinson Construction Company. His location at present will be at the Chicago office and Quincy, Ill., on the construction of a highway bridge across the Mississippi River.

ROLF T. RETZ, of Lyndhurst, N. J., who for the last two years has been bridge designer with the New Jersey State Highway Department on the design of the steel and reinforced-concrete viaduct being built in connection with the Holland tunnel, is now with the Central Hudson Gas & Electric Company, Poughkeepsie, N. Y., as structural designer.

WILLIAM F. CUMMINGS, maintenance-of-way engineer of the Boston & Maine Railroad, has been advanced to the post of assistant chief engineer. He will be in charge of engineering design, valuation, standards and real estate engineering. HAROLD F. FIFIELD takes Mr. Cummings' old post. JOSEPH A. PARRANT has been promoted from engineer of standards to principal assistant engineer, replacing CHARLES J. GRIFFIN, now construction engineer.

M. W. SERBY, formerly chief engineer for G. W. Thompson, consulting engineer, is now with the Rib-Stone Concrete Corporation, of LeRoy, N. Y., as chief engineer.

JOHN H. GREGORY, of the Johns Hopkins School of Engineering, Baltimore, has been employed by the Public Improvement Commission of Baltimore as a general consultant on subjects dealing with the new $10,000,000 water improvement projects of the city. He will assist Charles F. Goob, chief engineer of the city, and Edward G. Rost, water engineer.

Commander HENRY G. TAYLOR, Civil Engineer Corps, U. S. Navy, has been assigned to duty as public works officer of the Sixteenth Naval District. Until recently he was plant superintendent at the League Island Navy Yard.

ROBERT S. SUMNER, general manager of the Denver (Colo.) Water Company and formerly chief engineer for the Denver Water Board, has resigned.

HENRY J. SAUNDERS, formerly assistant supervising engineer, bureau of valuation, Interstate Commerce Commission, has opened an office as consulting engineer in Washington, D. C. He will practice before the Interstate Commerce Commission and and government departments.

Obituary

HENRY STEERS, president of Henry Steers, Inc., New York City, died Nov. 6 at his home in Port Chester, N. Y. He founded the firm which bears his name in 1904 and since that time had been directing head in the execution of much heavy construction in the railway field. At the present time the firm is engaged in building a bridge over Newark Bay for the Lehigh Valley and Pennsylvania railroads.

PATRICK F. O'BRIEN, city engineer of Quincy, Mass., died Oct. 31 at the age of 68. He had been city engineer almost continually since 1916. Previously Mr. O'Brien had worked eleven years for the Boston Transit Commission on the South Boston and Washington St. tunnels and seventeen years for the New York, New Haven & Hartford Railroad, during which time he was engaged on grade-crossing elimination in Fall River, Mass.

HERBERT D. CASHMORE, junior assistant sanitary engineer in the U. S. Public Health Service, died on Oct. 14 at Portland, Ore. At the time of his death he was attached to the Interstate Sanitary District office at San Francisco, Calif. He was 30 years old.

Construction Equipment and Materials

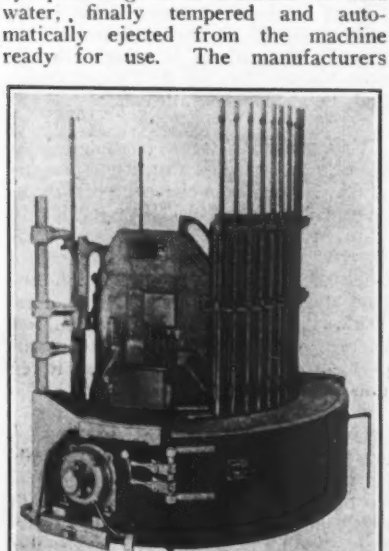
Ceramic Meeting and Show to Be Held in Chicago

An exposition of ceramic products is to be held in Chicago, Ill., Feb. 4-9, 1929, in connection with meetings of a number of ceramic organizations, including the American Ceramic Society, the Common Brick Manufacturers Association, the National Paving Brick Manufacturers Association, the National Brick Manufacturers Association and the Hollow Building Tile Association. Among the products to be exhibited will be many varieties of building and paving brick, drain tile and clay sewer pipe. Further information may be secured from Ross C. Purdy, 2525 North High St., Columbus, Ohio, secretary of the American Ceramic Society.

New Developments

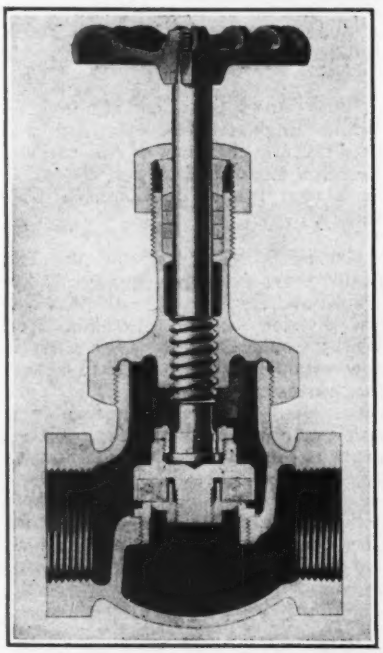
Automatic Machine Hardens and Tempers Drill Steel

Absolute control of the heating of rock drill steel to a temperature within 5 deg. of the critical range at the instant of quenching is claimed for a new automatic heat-treating machine recently developed by the Gilman Manufacturing Company, East Boston, Mass. As shown in the illustration, the drills are suspended on carriers from a circular track and extend through a rectangular slot in the upper cover of the electric furnace. The bits are heated to the critical temperature and then automatically removed from the furnace and hardened by quenching in a fountain of cold water, finally tempered and automatically ejected from the machine ready for use. The manufacturers claim that the elimination of the personal equation in drill sharpening effects a great reduction in the amount of drill steel required to perform a given amount of work.



Pressure Steam Valve Has Resilient Disk

The feature of a new line of bronze valves being produced by Jenkins Bros., New York City, is the renewable resilient disk, which conforms to the valve seat and insures a tight valve without regrinding. The valves are produced in sizes ranging from ¼ in. to 2 in. in globe, angle, cross, horizontal and angle checked patterns. Either screwed or flanged connections are available.



Four Wheels Drive Motor Grader

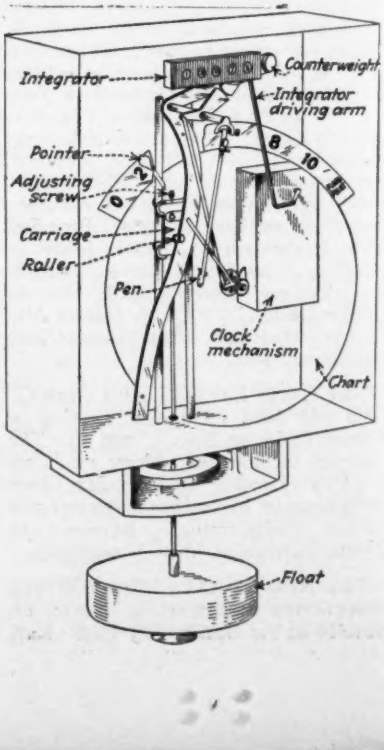
Sure traction in mud or soft ground without the accompanying disadvantages of the high power consumption and reduced speed of the crawler tread is claimed for a radically new motor grader recently announced by the Austin-Western Road Machinery Company, Chicago, Ill. The driving unit in this assembly is a McCormick-Deering 10-20 tractor, all the weight of which is carried on its own four driving wheels. The frame of the grader is attached to the rear axle of the tractor by heavy rocker beams, the front end of the tractor being carried by a spring support by its own drive wheels. While 6-in. solid rubber tires are standard equipment, it is possible to substitute 10-in. tires when it is necessary to obtain maximum tractive power.

The grader portion of the outfit is of the standard Austin-Western pattern, and is fitted with either leaning front wheels or an automotive type of steering of special design.

Improved V-Notch Weir Recorder

For measuring the flow of water the V-shaped weir has proved very satisfactory, particularly where there are wide variations in the rate of flow, because it is accurate at small fractional flows as well as at full flow. However, the fact that the discharge varies approximately as the 5/2 power of the head has introduced difficulties into the adaptation of automatic recorders to such installations.

A new solution to this problem is used in the Cochrane V-notch recorder, which is now being produced by the Cochrane Corporation, Seventeenth St. near Allegheny Ave., Philadelphia, Pa. As shown in the diagram, a sliding carriage on vertical rails bears against a cam moving in a vertical plane. Motion of the float is converted by this cam into radial motion of a steel shaft proportional to the rate of flow. This

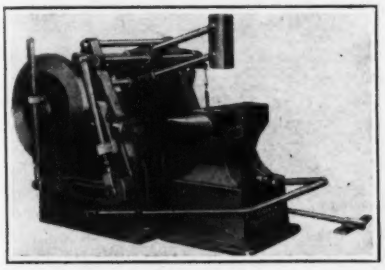


shaft carries a recording pen and also, through a link motion, a visible indicator moving along a semicircular dial. The chart which receives the pen record is driven by a clock mechanism, which also drives an integrating device.

The integrator mechanism consists of a train of gears and pinions, each gear having ten teeth and each pinion only one. The result is that all dials except the first advance a whole number at a time. The first gear is driven by a rod attached to a crank rotated by the clock. A clutch engages the milled edge of a disk mounted on a spindle of the first gear train pinion. Each stroke of the clock pulls the clutch back to the starting point, where it engages the milled disk and then pushes it forward until the clutch is thrown out of engagement by a separate cam, the position of which is determined by the position of the main cam and therefore by the rate of flow. Thus the counting train is advanced each time by an amount proportional to the flow, and the result for a period of time is totalized or integrated flow.

Power Smithing Hammer

A larger and heavier model of power hammer for use in blacksmith work, known as Model B, has been announced by the Blacker Engineering Company, New York City. The machine is driven



by a 1½-hp. motor which will deliver a maximum of 140 blows a minute of a hammer head weighing 50 lb. and so arranged that the striking face is always parallel to the anvil. The motor is connected to the driving shaft and flywheel through a fiber pinion and large driving gear. A special control mechanism enables the blow to be placed at any part of the anvil and gives exactly the weight of blow desired.

Fire-Fighting Equipment Uses Carbon Dioxide

Especially adaptable to inaccesible and fully inclosed places is the protection secured by the Alfite system of carbon dioxide protection against fire, which is now being produced by the American-La France & Foamite Corporation, Elmira, N. Y. Gas confined in a liquid state in metal cylinders under a pressure of approximately 1,000 lb. per sq.in. is used. The system is placed in operation by a plunger, which ruptures a copper disk used to seal the gas in the cylinder and permits it to pass through piping to nozzles located at the fire. Operation may be by hand, semi-automatic or completely automatic. The gas used is a special grade of carbon dioxide free from sulphur dioxide or any other contaminating gas. It is colorless and odorless and has 1½ times the density of air. It is claimed that carbon dioxide gas is not toxic, will not damage fabrics, machinery or electrical equipment and is not affected by cold. A dilution of 17 per cent in the ordinary room is sufficient to extinguish flame, but, in designing the system, a dilution of 35 per cent is provided to include an ample factor of safety. The system is not suitable for use in the open air.

Business Notes

Byers Machine Company, Ravenna, Ohio, has completed the removal of the Massillon Power Shovel Company, purchased late in 1927, from Massillon to Revenna. This is part of a plan of expansion which includes the acquisition of a fifteen-acre site and building recently vacated by the National Carbon Company to be used as an overflow from the present Byers plant. Ultimate plans call for developing a total of 20 acres.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces the appointment of H. H. Ashinger as assistant to the general manager and manager of engineering for the South Bend, Ind., works of the company.

Roller-Smith Company, New York City, has appointed Arthur H. Abbott, Inc., Boston, Mass., its district sales agent for the New England territory.

Terrill Gas Machine Lighting Company, New York City, has appointed F. E. Galvin, formerly with the U. S. Bureau of Foreign and Domestic Commerce, its sales manager with offices in New York City.

Prest-O-Lite Company, Inc., New York City, has opened a new gas plant at Birmingham, Ala., to supply the local demand for dissolved acetylene used in welding and cutting. A. J. Topham is plant superintendent.

Kennedy-Van Saun Manufacturing & Engineering Corporation, New York City, has established the Kennedy-Van Saun Company of Illinois, with offices at Chicago in charge of T. J. Shearer, manager.

Chase Brass & Copper Company, Waterbury, Conn., has selected Cleveland, Ohio, as the location for its proposed Mid-West plant to be erected in the near future.

Barber-Greene Company, Aurora, Ill., has added to its list of distributors the Jenison Machinery Company, San Francisco, Calif., and the Howard-Cooper Corporation, Portland, Ore.

New Publications

Dump Bodies—Differential Steel Car Company, Findlay, Ohio, describes the differential three-way dump body for motor trucks in a recent bulletin, No. D-23. A number of photographs show typical adaptations of the body to various makes of trucks.

Acoustic Plaster—United States Gypsum Company, Chicago, Ill., has issued a 32-page illustrated booklet which discusses the solution of acoustical problems in auditoriums and similar interiors and also describes Sabinite acoustical plaster, a product of the company. The book gives a number of charts, formulas and tables useful in the design of auditoriums and similar structures.

Excavating Machinery—Northwest Engineering Company, Chicago, Ill., has issued a new and revised catalog describing all models of shovels, draglines, cranes, pull-shovels and skimmer scoops manufactured by the company. Complete tabular data are included, giving operating ranges and capacities for the various models.

Steel Roofs—Truscon Steel Company, Youngstown, Ohio, in bulletin No. 206 describes the Truscon Steeldeck roofs, including both I-plate and Ferrodeck types. A number of tables and graphs are included in the bulletin giving structural and designing data for determining the amount of insulation and waterproofing needed on any given roof to prevent heat loss and condensation.

Lubricants — Acheson Graphite Corporation, Niagara Falls, N. Y., includes many facts of engineering interest in a new book called "Industrial Lubrication." This contains a complete treatment of the theory of lubrication, discusses the characteristics of various grades of lubricants and gives definite recommendations for the efficient lubrication of all kinds of gears and bearings.

Material - Handling Equipment — Lakewood Egineering Company, Cleveland, Ohio, has issued catalog No. 16A describing narrow-gage cars and tracks, trailers, trucks, loading skips, carts and concrete buckets.

Sheet Piling—Sheet Piling, Inc., New York City, has issued a bulletin which illustrates the various sections of Larssen steel sheet piling, including special junctions, crosses and bends, and gives photographs of several recent installations.

Gas Holders—Chicago Bridge & Iron Works, Chicago, Ill., has issued a book entitled "Storing Gas at High Pressure" which describes the Hortonsphere, a globular gas holder and contains tables of standard capacities and also tables giving detailed tabular costs of high-pressure gas transmission.

The Business Side of Construction

Competition Reflected in Narrow Profit Margins

Narrow profit margins in competitive industry and trade have come to stay, because they are an inevitable characteristic of the trend toward large-scale enterprise and mass production, which have grown out of technological progress and the mechanization of industry. This is the conclusion of the National Industrial Conference Board based on a comprehensive analysis of profit ratio to sales and capital investment of more than 4,000 large and successful industrial, mercantile and other corporations over a period of post-war years, 1918-25.

The results of this study emphasize not only the hazard incurred today by all competitive business, large and small, because of narrow profit margins but also the potential profitableness of efficient large-scale production. Sales at prices closely approximating cost of production are the dominant factor in determining commodity prices, forcing producers and merchants to seek profit by volume rather than profit by individual sale. Approximately half the sales of the large and successful corporations selected for analysis annually was made at less than 5 per cent profit in most of the manufacturing industries; in trade, particularly the wholesale trade, more than half of the sales were made at a profit of less than 5 per cent or at a loss. The average amount of sales at low profit rates or at a loss for all corporations is estimated to be even greater.

This condition, however, does not necessarily result in a low return on capital invested, but rather tends to accelerate turnover of capital and thus may result in high returns, although half the output is disposed of at prices very close to production costs and a portion even at a loss. Corporations operating at the lowest rate of profits on sales were found to have ordinarily the highest turnover of capital and often, therefore, are among those enjoying the highest return on capital.

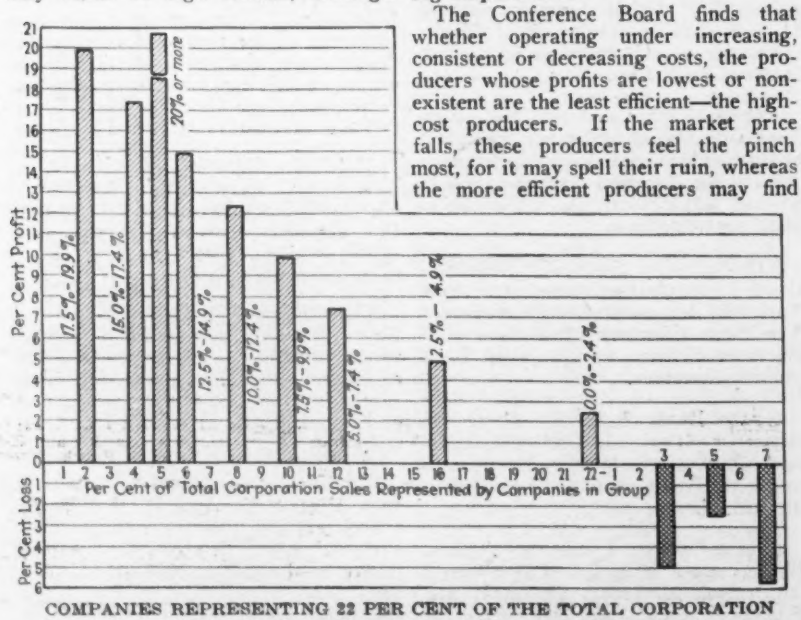
E. N.-R. Index Numbers

Cost			Volume		
Nov. 1,	**1928**	**209.46**	**October,**	**1928**	**363**
Oct. 1,	1928	207.71	September,	1928	296
Nov. 1,	1927	201.98	October,	1927	269
Average,	1927	206.24	Average,	1927	263
Average,	1926	208.03	Average,	1926	228
1913.....		100.00	1913.....		100

The exact proportionate amount of the total business of all corporations transacted at a loss cannot be determined with the present available statistical data. Almost every corporation, however, makes a portion of its sales at a loss, even though a net profit is realized in the grand total.

Although more than 4,000 selected corporations whose transactions were specifically studied by the Conference Board include almost all of the large successful corporations in the country, every year during the period considered the total operations of some of them resulted in a loss; on an average corporations operating at a loss handled about 5 per cent of the total sales of all of the selected corporations under scrutiny. When all manufacturing corporations in the country are considered as one group, it is found that those operating at a loss transacted about 13 per cent of the business of the group; trading corporations operating at a loss transacted about 18 per cent of the total business of all trading corporations.

The Conference Board finds that whether operating under increasing, consistent or decreasing costs, the producers whose profits are lowest or nonexistent are the least efficient—the high-cost producers. If the market price falls, these producers feel the pinch most, for it may spell their ruin, whereas the more efficient producers may find their total profits lowered, or unaffected, or even increased by the fall of price. The lower price may give to these more efficient producers the sales formerly made by the less efficient.



COMPANIES REPRESENTING 22 PER CENT OF THE TOTAL CORPORATION SALES REPORT LESS THAN 2.4 PER CENT PROFIT

Common Labor Rates in Construction Second Highest of 13 Industries

Top prices for common labor are paid by the automobile industry, according to a study made recently by the U. S. Bureau of Labor Statistics. This average rate of 57.2c. per hour is followed by 47.4c. for the construction industry. The contrast of the characteristics of the two industries is brought out in the range between high and low wages. Using low as base, the difference in the automobile industry is 88 per cent; in the construction industry 450 per cent. Examples of small range between high and low in industries that are concentrated and are accustomed to regular demands are meat packing and electrical machinery. In the former the top rate for common labor is only 32 per cent above the bottom rate; in the latter 78 per cent above. The study is based entirely on "entrance" or beginners' rates.

Although the lowest average rate paid common labor at the start is to be found in the sawmill industry, the top rate paid in that industry is third highest, being 62.5c., the same as in the leather industry.

The Bureau of Labor Statistics has weighted the average entrance rate per hour for the thirteen industries studied and presents a general figure for July 1 of the last three years as follows: 1926, 42.8c; 1927, 42.6; 1928, 44.9.

In this connection it may be noted that *Engineering News-Record's* average common labor rate for twenty cities is 55.75c. per hour for July 1, 1928. This figure is the average of rates prevailing in the building trades and is not to be confused with an average of entrance rates. Prevailing wages on that date varied from 25c. to 55c. at Atlanta to 90c. in Cincinnati and 90⅞c. in New York. Entrance rates in these trades as compiled by the government range from $0.175 to $1.125, indicating increased wage standardization with length of employment or experience.

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Nov. 5, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

	Nov. 5, 1928	Oct. 30, 1928	Nov. 8, 1927
Buildings:			
Industrial.....	$6,502	$4,589	$ 48,275
Commercial.....	25,953	41,578	26,869
Streets and roads..	5,217	10,870	3,308
Other construction.	13,834	15,463	4,447
Total.....	$51,506	$72,500	$82,899
Total, all classes, Jan. 1 to Nov. 5:			
1928.....			$3,159,465
1927.....			2,777,954